STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING

BULLETIN NO. 62

RECOMMENDED WATER WELL CONSTRUCTION AND SEALING STANDARDS

MENDOCINO COUNTY

GOODWIN J. KNIGHT
Governor

HARVEY O. BANKS
Director of Water Resources

November, 1958

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STATE OF CALIFORNIA
Department of Water Resources
SACRAMENTO

November 25, 1958

Honorable Goodwin J. Knight, Governor,
and Members of the Legislature of
the State of California

North Coastal Regional Water Pollution
Control Board

Gentlemen:

I have the honor to transmit herewith Bulletin No. 62 of the Department of Water Resources entitled "Recommended Water Well Construction and Sealing Standards, Mendocino County". This report has been prepared under authority of Section 231 of the Water Code. The investigation was conducted and report prepared by the Division of Resources Planning of the Department of Water Resources.

This report is the first of a series of reports designed to formulate and recommend areal standards of water well construction and sealing in order to adequately protect the waters of the State from quality impairment caused by improperly constructed, defective, or abandoned wells. The recommended standards presented are based on physical conditions and current well construction practices found in Mendocino County.

While there are at present no statewide laws in California setting forth standards for well construction and sealing, the Legislature recognized the need for such standards in the enactment of Chapter 1552, Statutes of 1949, by directing the Department of Water Resources to formulate minimum standards of well construction and procedures for the abandonment of wells. This report is designed to assist those who may undertake to formulate legislation or regulations for control of well construction and sealing practices in Mendocino County.

Very truly yours,

Harvey O. Banks

HARVEY O. BANKS
Director

ACKNOWLEDGMENT

The voluntary and valuable cooperation received from the following public and private agencies, and individuals is gratefully acknowledged.

United States Department of the Army, Corps of Engineers

United States Geological Survey, Ground Water Branch and Quality of Water Branch

California State Department of Public Health, Bureau of Sanitary Engineering

North Coastal Regional Water Pollution Control Board (No. 1)

Mendocino County Agricultural Commissioner

Mendocino County Health Department

Associated Drilling Contractors

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Crislip Drilling Company, Santa Rosa

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Holz Company, Ukiah

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Louis J. Lareau, Fort Bragg

Harold F. Nutting, Santa Rosa

Precision Drilling Company, Santa Rosa

C. T. Smalley, Potter Valley

George W. Taylor, Ukiah

C. H. Thomas, Laytonville

W. C. Thompson and Son, Sebastopol

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RECOMMENDED WATER WELL CONSTRUCTION
AND SEALING STANDARDS
MENDOCINO COUNTY

CHAPTER I. INTRODUCTION

Authorization

Intensive utilization of ground water for domestic, irrigation, and industrial uses throughout the State has focused attention on the need for protection of the quality of ground water through adequate standards of water well construction and proper sealing of abandoned wells.

Legislation providing authority for formulation of appropriate standards was enacted as Chapter 1552, Statutes of 1949, now Section 231 of the Water Code, which reads:

> "231. The department, either independently or in cooperation with any person or any county, state, federal or other agency, shall investigate and survey conditions of damage to quality of underground waters, which conditions are or may be caused by improperly constructed, abandoned or defective wells through the interconnection of strata or the introduction of surface waters into underground waters. The department shall report to the appropriate regional water pollution control board its recommendations for minimum standards of well construction in any particular locality in which it deems regulation necessary to protection of quality of underground water, and shall report to the Legislature from time to time, its recommendations for proper sealing of abandoned wells."

This investigation has been conducted and the report prepared in compliance with this section of the Water Code.

Statement of Problem

The alluvial and valley fill areas of Mendocino County supply water to an estimated 4,000 wells. Nearly 80 per cent of these wells supply ground water primarily for domestic and municipal uses. The remaining 20 per cent supply ground water for irrigation and minor industrial purposes. It is estimated that 85 per cent of domestic water supplies and 70 per cent of irrigation water are derived from ground water storage.

In Mendocino County hundreds of new water wells are constructed annually, and many others are abandoned. If these wells are not properly constructed initially or are not satisfactorily sealed upon abandonment, they may permit impairment of the quality of ground water.

In order to protect the usefulness of ground water storage and to provide maximum assurance that the ground water will be suitable for the beneficial uses intended, it is essential that adequate standards of well construction and sealing be formulated and adopted.

Scope of Investigation and Report

The investigation included an identification of valley fill areas within Mendocino County capable of storing, transmitting, and yielding ground water and included a reconnaissance geologic survey of such areas.

A comprehensive survey of representative water wells throughout the county was made to determine present sanitary conditions, types of wells, and standards of construction.

Representative samples of ground and surface water for standard mineral analysis and samples of ground water for bacteriological examination were obtained throughout the county for determination of present water quality conditions and evaluation of present or potential sources of contamination, pollution, and degradation.

Determinations of most probable number (MPN) of coliform organisms were made on 184 ground water samples to evaluate the effects of possible sources of contamination observed during the well canvass.

Interviews were conducted with well drillers operating, or known to have operated, in Mendocino County.

Other than measurements of depth to ground water, no field work investigating hydrologic or climatological data was performed; available data were compiled.

The report includes evaluation of results of a geologic reconnaissance survey, compilation and interpretation of data on hydrology and water quality, and a description of prevalent methods and materials used in well construction and sealing. Recommendations for standards of well construction and sealing considered necessary for protection of ground water in valley fill areas are presented in the report. However, recommendations are not made regarding procedures for protection of quality of water in distribution and storage systems, since these matters are the responsibility of local health authorities and the Bureau of Sanitary Engineering, State Department of Public Health.

Comments and recommendations are presented herein refer specifically to Mendocino County.

Prior Investigations and Reports

The following reports, containing information pertinent to evaluation of ground water conditions and establishment of water well construction and sealing standards in Mendocino County, were reviewed in connection with the current investigation. Reference is made to these reports in the text by means of numbers in parenthesis; e.g., (1).

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26. United States Department of Commerce, Bureau of the Census. "1950 United States Census of Population, California, Number of Inhabitants". 1951.

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Review of Preliminary Edition of Bulletin No. 62

A preliminary draft of this report was released to various interested individuals, agencies, and organizations for review and comments in September 1956. Hearings on the preliminary draft were held on December 5, 1956, and August 7, 1957, with the Legislative Committee of the Associated Drilling Contractors. All comments and recommendations submitted by these parties were reviewed and analyzed and have been considered in revising this report.

Area of Investigation

Location

Mendocino County is located in the northwest coastal section of California, between the Pacific Ocean and Sacramento Valley. The southern bounday is approximately 80 miles north of the City of San Francisco. The county is located between 38°45' and 40°00' north latitude and between 122°50' and 124°00' west longitude. The width varies between a maximum of 58 miles and a minimum of 32 miles and the length varies from 84 miles to 77 miles. Mendocino County is bordered on the south by Sonoma County, on the east by Lake, Glenn, and Tehama Counties, and on the north by Trinity and Humboldt Counties. The Pacific Ocean forms the western boundary. The county encompasses an area of approximately 3,510 square miles. General location is shown on Plate 1, and an index to alluvial areas on Plate 2.

Physiography

Mendocino County encompasses a series of mountain ridges and intermontane valleys of the Coast Range. The ridges and valleys vary greatly in width, height, and topographic detail and are oriented in a northwest-southeast direction, roughly parallel to major rift and fault zones which pass through the area.

Elevations range from sea level to the 6,963-foot elevation of Anthony Peak located in the northeast section of the county. Topography varies from precipitous and deeply dissected landscapes to gentle slopes, rolling hills, and intermontane valleys.

Physiographic features reflect the folding, faulting, and uplift by which the Coast Range was developed. Rapid subsequent erosion on lines of structural weakness has stripped enormous volumes of sediments from the area.

Structural bowls and troughs were formed in the Coast Range during periods of intense folding and faulting. Major valleys reflect the shape of structural depressions as modified by effects of deposition and erosion. Several valleys are trough-like: Anderson Valley and portions of Sanel, Ukiah, and Laytonville Valleys. Down cutting by streams has developed prominent terraces in Laytonville, Ukiah, and Anderson Valleys.

The central segments of Mendocino County are characterized by a series of uplifted marine terraces varying greatly in width. These terraces lie between rugged sea cliffs and the steep hills and ridges of the Coast Range.

Climate

Mendocino County has two distinct types of climate. These are classed as Mediterranean (Csa) and Temperate Marine (Cb) as proposed by Kippen and modified by Trewartha (22).

Mediterranean climate is found in all the interior valleys and is characterized in this area by relatively warm, dry summers and wet, cool winters. Mean temperature varies from an average of approximately 45° F. in January to between 70 and 75° F. in July. Precipitation varies between 35 and 70 inches per year, nearly all occurring between October and May. A few cloudy days occur in the summer; warm days are the rule although the nights are quite cool. Winter storms are often followed by clear, pleasant days.

Temperate Marine climate is found only along the coast line. It is characterized by relatively even temperatures and by considerable fog and low clouds. Diurnal and seasonal variations of temperature are less pronounced than those in the interior area. Precipitation averages 35 to 40 inches per year, and mean temperatures vary from 49° F. in January to 56° F. in July and August.

Major storm systems passing over the country move in a southeast direction. Precipitation decreases from north to south and is also greatly influenced by orographic barriers. Therefore, while the precipitation tends to decrease in a southerly direction, there are wide variations of amount and intensity depending upon altitude and location. Storms moving through the area are primarily controlled by the location of the permanent or semi-permanent zone of high barometric pressure commonly known as the "Pacific High". During the summer season this zone normally lies to the northwest of Mendocino County, but during the winter season it normally retreats to the southwest. Location of the "Pacific High" determines whether storms generated in the north Pacific area can move inland through Mendocino County or whether they will be diverted northward.

Eleven meteorological stations either have been or presently are maintained by the United States Weather Bureau (27) in Mendocino County.

Locations of the stations, types of data recorded, periods of record and averages for periods of record are shown in Table 1. More detailed data from these stations are published by the United States Weather Bureau and are not included in this report.

Stream Systems

Mendocino County is divided into three major drainage systems: Eel River, Russian River, and the coastal drainage area (Plate 2).

The northern half of the county lies in the Eel River watershed. This watershed has an area of 3,700 square miles, of which 1,550 are in Mendocino County. Principal tributaries of the Eel are its North, Middle, and South Forks. The system as a whole displays a highly irregular drainage pattern, with stream channels following, in many instances, the lines of structural weakness in the contorted rocks of the Franciscan-Knoxville group.

The southeasterly portion of Mendocino County, comprising about 15 per cent of its area of 515 square miles, is drained by the Russian River. Supplementing this drainage, about 140,000 acre-feet of water is imported annually from Eel River through the Potter Valley power house. Much of this water is subsequently used for irrigation and other purposes.

The third major watershed group, designated as the "coastal drainage area", comprises a strip along the Pacific Coast extending the entire north-and-south length of the county. Its streams are relatively short, their profiles steep, and valleys small. Subdivisions of this group are shown in Table 2.

TABLE 1

UNITED STATES WEATHER BUREAU[a]
METEOROLOGICAL STATIONS
MENDOCINO COUNTY

Area	Station	Elevation in feet	Period of record: Temperature	Period of record: Precipitation	Mean for period[b]: Temperature in °F.	Mean for period[b]: Precipitation in inches
Anderson Valley	Yorkville	1,150	None	1941-	--	47.64
Sanel Valley	Hopland Largo Station	550	None	1940-	--	38.68
Fort Bragg	Fort Bragg	74	1893-	1893-	52.9	37.48
Laytonville Valley	Laytonville	1,640	None	1941-	--	56.20
Point Arena	Point Arena Light Station	60	1950-	1950-	50.9	35.13
Potter Valley	Potter Valley Powerhouse	1,014	1939-	1912-	58.4	41.08
Round Valley	Covelo	1,390	1940-	1919-	56.1	38.22
Ukiah Valley	Redwood	718	None	1938-	--	36.07
Ukiah Valley	Ukiah	623	1893-	1872-	57.8	35.35
Little Lake Valley	Willits	1,365	None	1888-	--	50.07
Leggett Valley	Cummings	1,324	None	1928-	--	67.81

a Data from U. S. Department of Commerce, Climatological Data (27).
b Period is from beginning of record to 1955.

TABLE 2

COASTAL STREAMS
MENDOCINO COUNTY

Stream	Total drainage area in square miles
Ten Mile River Group	26
Noyo River Basin	114
Big River Group	290
Navarro River Basin	316
Alder Creek Group	124
Garcia River Basin	114
North Fork Gualala River	125

As shown in Table 3, there are 14 stream gaging stations which are, or have been, maintained in the county. Data listing years of record, average discharge, and area drained by each stream at the station are given.

Detailed discharge records obtained from these gages are published annually by the United States Geological Survey (29) and are not included in this report.

TABLE 3

STREAM GAGING STATIONS[a]
MENDOCINO COUNTY

Stream and location of gaging station	Period of record	Average discharge in cubic feet per second, for period[b]	Drainage area in square miles
South Fork Eel River near Miranda	1940-	1,750	547
South Fork Eel River near Branscomb	1946-	166	44
Middle Fork Eel River below Black Butte River near Covelo	1951-	1,310	367
Eel River at Hullville	1922-	490	289
Eel River at Van Arsdale Dam near Potter Valley	1922-	563[c]	347
Eel River above Dos Rios	1950-	1,876	703
Eel River below Dos Rios	1951-	4,103	1,481
Potter Valley Powerhouse Tailrace near Potter Valley	1909-	197	---
East Fork Russian River near Calpella	1942-	302[d]	94
East Fork Russian River near Ukiah	1951-	440[d]	104
Russian River near Hopland	1940-	684[d]	362
Russian River near Cloverdale	1951-	1,228	502
Navarro River near Navarro	1950-	657	304
Noyo River near Fort Bragg	1951-	323	105

a All records compiled by United States Geological Survey.
b Period is from beginning of record to 1953.
c Includes diversion to East Fork Russian River from Eel River.
d Includes effect of diversion to East Fork Russian River from Eel River.

Present Cultural Development

Agriculture. The total land area of Mendocino County is about 2,246,000 acres, of which farm land constitutes nearly 50 per cent. Approximately 900,000 acres, or 80 per cent of the total agricultural land, are utilized as livestock range and fenced natural pasture (18). About 100,000 acres are devoted to irrigated pasture or cultivation. The most important crops are grain, vetch hay, alfalfa, sudan grass, hops, grapes, and fruits. Acreage of cereal crops has decreased in the past few years, being replaced mainly by pasture. Acreage devoted to horticulture and viticulture, although representing but a small percentage of the total agricultural land, accounts for approximately one-third of the agricultural income. Wine grapes, followed by pears and apples, are the most important fruit.

Livestock raising is a major agricultural activity. Sheep are presently the most important, followed in order by cattle, hogs and poultry. Sheep, beef cattle, and hogs are raised throughout the county, and dairy cattle are concentrated in Potter Valley and along the coastal areas. Poultry production is of importance in the Fort Bragg area.

Industry. At present the largest source of income in the country is the production and manufacture of lumber and wood products. Approximately 1,200,000 acres of commercial timberland supply lumber mills and lumber by-product plants throughout the county. Mining of chromium, mercury, and copper ore supplies a relatively small income.

During the summer months tourist trade in the county represents a significant source of income along the heavily traveled highways. Many motels, resorts, restaurants, and other businesses derive a large portion of their income from this source. Commercial and sport fishing is a material source of income along the coastal segment of the county

Population. The population of Mendocino County (26) increased 46.6 per cent from 27,864 in 1940 to 40,854 in 1950. The major areas of population in the county are shown in Table 4.

TABLE 4

POPULATION
MENDOCINO COUNTY

Location	1940 Census	1950 Census
Anderson Valley Area	1,010	2,368
Areas contiguous to Point Arena	1,058	1,273
Point Arena	374	372
Areas contiguous to Fort Bragg	5,247	7,445
Fort Bragg	3,235	3,826
Little Lake Valley Area contiguous to Willits	1,258	2,602
Willits	1,625	2,691
Laytonville Valley Area	883	1,626
Round Valley Area	1,571	1,357
Sanel Valley Area	1,042	1,163
Ukiah Valley Area contiguous to Ukiah	6,830	10,011
Ukiah	3,731	6,120
Totals for Mendocino County	27,864	40,854

Anderson, Little Lake, Laytonville, and Ukiah Valleys were the areas of most rapid population growth in the decade between 1940 and 1950. This increase is based on expansion of lumbering and its allied industries and of tourist activity. Urban population was 39 per cent of the total in 1950, rural population accounting for 61 per cent. More than 90 per cent of the people of the county live in the seven major valleys and in the coastal segment.

Four cities, Fort Bragg, Point Arena, Ukiah, and Willits, are served with community sewer systems. Fort Bragg has a collection system which discharges raw sewage to the ocean through three outfalls. Point Arena has a sewage collection system with septic tank treatment and discharge to Ross Creek. Ukiah is served by a collection system and by a treatment plant consisting of primary sedimentation, separate sludge digestion, and percolation-oxidation ponds; seasonal pond overflow is chlorinated before discharge to Russian River.

Ukiah Village Sewer Maintenance District, south of and adjacent to Ukiah, collects and treats sewage from 287 homes. Treatment is by the activated sludge process, and effluent is discharged into Russian River. In 1949 Willits constructed a sewage treatment plant consisting of primary clarifier, separate sludge digestion, and oxidation ponds. Effluent is discharged to Broaddus Creek. Mendocino State Hospital at Talmage and Masonite Corporation north of Ukiah also have domestic sewage collection and sewage treatment systems.

Total population served by sewage collection and/or treatment systems is estimated to be 12,300 or 30 per cent of the total 1950 population of the county. Eighty-five per cent of the 1950 urban population of Mendocino County are served by community sewer systems.

Transportation. The major highway serving Mendocino County is U. S. Highway 101, which extends in a northerly direction through the entire length of the county. This highway is the main route to all of the north coastal areas from San Francisco to the Oregon border. State Highway 1 also serves Mendocino County northerly along the coast from Point Arena to north of Rockport, where it swings inland and connects with U. S. Highway 101 a few miles north of Cummings. Other primary highway routes in the county includes State Highway 20, which extends from the eastern boundary of Mendocino County in the vicinity of Lakeport to U. S. Highway 101 just north of Ukiah, and State Highway 128, which extends from Cloverdale west to the mouth of the Navarro River, where it connects with State Highway 1. In addition to the primary highway system there are numerous secondary roads. Mendocino County is also served by a line of the Northwestern Pacific Railroad, which roughly parallels the course of U. S. Highway 101 from north to south. There are airline connections at Ukiah and Fort Bragg.

Definitions

Ground water unit - a body of permeable materials underlain by less permeable rocks and bounded by less permeable rocks and/or other ground water units. Ground water available in a ground water unit may be in quantities sufficient for exploitation or in relatively minor quantites, and it may be of satisfactory or inferior mineral quality. Ordinarily ground water units yield water to wells in adequate quantity and suitable quality for most beneficial purposes; however, the delinaation of a ground water unit herein neither implies nor assumes either the occurrence of ground water throughout the unit or suitability of water quality.

Ground water basin - a ground water unit known to contain usable ground water in sufficient quantities to permit exploitation.

Aquifer - a geologic formation or structure sufficiently permeable to yield water to wells or springs.

Free ground water - a body of ground water not under pressure and not overlain by impervious materials, moving under the control of the water table slope.

Confined ground water - a body of ground water which is immediately overlain by material sufficiently impervious to sever free hydraulic connection with overlying water and which moves under pressure caused by the difference in head between the intake or forebay area and the discharge area of the confined water body.

Alluvium - includes undeformed valley fill and marine terrace deposits, and slightly deformed, poorly consolidated valley fill deposits.

Water well - any excavation for the purpose of obtaining ground water.

Domestic water well - any water well from which all or part of the water is used for culinary, domestic, or other uses common to a household.

Industrial water well - a well used to obtain ground water primarily for industrial purposes but not used to supply water for domestic purposes.

Irrigation water well - a well used to obtain ground water primarily for the purpose of supplying water for consumptive use requirements of crops, stockwatering use, or other agricultural use, but not used to supply water for domestic purposes, except incidentally to its principal use.

Municipal water well - any water well owned and/or operated by an organization, one of the principal purposes of which is to supply water to multiple consumers for culinary, domestic, industrial, or other uses.

Artesian well[a] - any artificial hole in the ground through which water naturally flows from subterranean sources to the surface of the ground for any length of time.

Composite well log - as used herein incorporates excerpts from several well logs to represent in one log the variety, relationship, and approximate proportion of sediments underlying a specified area. When permission to publish specific well logs has not been obtained, a composite log is frequently used as a substitute.

Irrigation return water- that portion of applied irrigation water, in excess of consumptive use requirements, available for re-use. It may drain off to surface streams or infiltrate to ground water in areas of free ground water.

Juvenile water[b] - new water of magmatic, volcanic, or cosmic origin added to the terrestrial water supply.

Contamination[c] - impairment of the quality of the waters of the State by sewage or industrial waste to a degree which creates an actual hazard to the public health through poisoning or spread of disease.

Pollution[c] - impairment of the quality of the waters of the State by sewage or industrial waste to a degree which does not create an actual hazard to the public health, but which does adversely and unreasonably affect such waters for domestic, industrial, agricultural, navigational, recreational, or any other beneficial use.

Degradation - any impairment of the quality of water due to causes other than the disposal of sewage and industrial wastes.

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a - As defined in Section 300 of the Water Code.
b - As defined by Tolman, C. F. (21).
c - As defined in Section 13005 of the Water Code.

Degradant - any material which causes degradation.

Parts per million (ppm) - is defined as one weight of solute per one million weights of distilled water at 20° C.

Equivalent weight - is used herein as the molecular weight of any element, radical, or compound divided by the valence. One equivalent of any element, radical, or compound is exactly equal in combining power to one equivalent of another element, radical, or compound.

Equivalents per million (epm) - is used herein as ppm divided by the equivalent weight of the ion or substance. An epm is equal to a milliequivalent per liter (me/l) for concentrations of dissolved solids normally present in natural waters.

Location References and Well Numbers

Location numbers presented herein are referenced to the Mount Diable Base and Meridian of the United States Public Land Survey system, except in the extreme northern end of the county where they are referenced to the Humboldt Base and Meridian. Well numbers consist of township, range, section number, a letter which indicates the quarter-quarter section in which the well is located, and a final number which indicates the identity of the particular well. The subdivision of the section is shown as follows.

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

For example, 15N/12W 23A2 MDB&M, is the number of a well located in section 23 of Township 15 North, Range 12 West, referenced to the Mount Diablo Base and Meridian, while A2 indicates it is the second well to be numbered in the northeast quarter of the northeast quarter of that section. Surface water locations are given an additional letter of S following the location number to differentiate from ground water locations. Thus 15N/12W-23A1S, MDB&M, would indicate a surface water location.

Throughout the report the base and meridian have been omitted from location numbers, except from those which fall within the Humboldt Base and Meridian.

CHAPTER II. GEOLOGY, HYDROLOGY, AND WATER QUALITY OF THE ALLUVIAL AREAS OF MENDOCINO COUNTY

Introduction

Eighty-two areas in Mendocino County have been classified in this survey as ground water units. The total alluvial area therein is approximately 250 square miles. Seven ground water units have been classified as major basins and contain a total of 148.2 square miles of alluvial area. Two ground water units have been classified as coastal terraces. These coastal terraces include 31 areas classified as minor units and have an aggregate area of 72.0 square miles. The remaining 42 minor ground water units contain a total of 30.2 square miles. Area of each unit and the name and number assigned in accordance with the procedure established in Water Quality Investigations Report No. 3 entitled "Ground Water Basins in California" (11) are shown in Table 5 entitled "Ground Water Basins". Location of each area is shown on Plate 2.

Major basins range in size from Ukiah Valley, which contains 64.9 square miles of alluvial area, to Anderson Valley, which contains 7.9 square miles. Alluvial area of the major basins averages 21.2 square miles. Minor units range in size from South Fork Eel River Valley to Hardy Creek Valley, which encompass 4.65 square miles and 0.02 square mile respectively.

Areas classified as major ground water basins include Anderson, Laytonville (known locally as Long Valley), Little Lake, Potter, Round, Sanel (also known as Hopland Valley), and Ukiah Valleys. In general these basins contain extensive and sometimes relatively thick areas of alluvial deposits capable of storing, transmitting, and yielding ground water. Depth of valley fill deposits is thought to reach a maximum of over 1,400 feet in Ukiah Valley; however, no wells are known to have penetrated deeper than 500 feet. Alluvium in Round Valley is known to be deeper than 800 feet.

Areas comprising the coastal segment of the county include Fort Bragg Terrace and Point Arena Terrace and their contiguous areas; these include 31 ground water units classified as minor ground water basins. In these areas alluvial and terrace deposits normally do not exceed 25 feet in thickness.

Maximum depth of alluvial material ranges between the extremes of 500 to 1500 feet in the remainder of the major ground water basins. The remaining 42 minor alluvial areas throughout the county are generally shallow in depth and are capable of storing, transmitting, and yielding ground water in varying, but generally small, quantities.

TABLE 5

GROUND WATER BASINS
MENDOCINO COUNTY

Number	Name	Alluvial area in square miles	Number	Name	Alluvial area in square miles
		Major Valleys			
1-11	Round	22.58	1-15	Ukiah	64.92
1-12	Laytonville	11.66	1-16	Sanel	11.46
1-13	Little Lake	17.44	1-19	Anderson	7.90
1-14	Potter	12.20			
				Total - Major Valleys	148.16
		Coastal Terraces			
1-20	Point Arena Terrace and Contiguous Areas	30.14	1-21	Fort Bragg Terrace and Contiguous Areas	41.86
				Total - Coastal Terraces	72.00
		Minor Valleys Included in Coastal Terraces			
1-35	Juan Creek		1-78	Albion River	
1-63	Howard Creek		1-79	Salmon Creek	
1-64	DeHaven Creek		1-80	Navarro River	
1-65	Wages Creek		1-81	Greenwood Creek	
1-66	Abalobadiah Creek		1-82	Cliff	
1-67	Seaside Creek		1-83	Alder Creek	
1-68	Ten Mile River		1-84	Staramella Ranch	
1-69	Little		1-85	Brush Creek	
1-70	Pudding Creek		1-86	Garcia River	
1-71	Mill Creek		1-87	Point Arena Creek	
1-72	Noyo		1-88	Mate Creek	
1-73	Hare Creek		1-89	Ross Creek	
1-74	Casper Creek		1-90	Galloway Creek	
1-75	Russian Gulch		1-91	Schooner Gulch	
1-76	Big River		1-92	Gualala River	
1-77	Little River				
		Other Minor Valleys			
1-22	Mattole River	0.45	1-27	Blue Rock Creek	0.05
1-23	Indian Creek	0.14	1-28	Williams	2.12
1-24	South Fork Eel River	4.65	1-29	Poor Mans	0.30
1-25	Summit	0.22	1-30	Jackass Creek	0.05
1-26	Hulls	0.29	1-31	Usal Creek	0.24

TABLE 5

GROUND WATER BASINS
MENDOCINO COUNTY
(continued)

Number	Name	Alluvial area in square miles	Number	Name	Alluvial area in square miles
		Other Minor Valleys (cont'd)			
1-32	Hollow Tree Creek	0.59	1-51	Parlin Fork	0.08
1-33	Cottoneva Creek	0.60	1-52	North Fork Big River	0.52
1-34	Hardy Creek	0.02	1-53	North Fork Albion River	0.25
1-36	Branscomb	1.92	1-54	Comptche	0.26
1-37	Eden	1.56	1-55	Cold Creek	0.62
1-38	Elk Creek	0.76	1-56	Ornbaun	0.20
1-39	Hearst	0.75	1-57	Rancheria Creek	
1-40	Ryan Creek	0.08	1-57.1	Yorkville	0.26
1-41	Wheelbarrow Creek	0.34	1-57.2	Hibbard Ranch	0.03
1-42	Sherwood	1.20	1-57.3	Hulbert Ranch	0.24
1-43	Curley Cow Creek	1.41	1-58	Dry Creek	
1-44	Rowes Creek	0.18	1-58.1	The Oaks	0.10
1-45	Outlet Creek	0.56	1-58.2	Ingram	0.46
1-46	Scott Creek	0.36	1-59	Edwards Creek	0.21
1-47	Tomki Creek	0.73	1-60	High	0.13
1-48	Van Arsdale	1.45	1-61	Pieta Creek	0.14
1-49	Forsythe Creek	0.62	1-62	Tyler Creek	0.10
1-50	Noyo River		1-93	McDowell	2.29
1-50.1	Camp Marwedel	0.14	1-94	McNab Creek	1.93
1-50.2	North Fork Noyo River	0.72	Total -	Other Minor Valleys	30.17
1-50.3	Irmulco	0.85	Total -	Mendocino County	250.33

Ground Water Geology and Hydrology

Geolgoic investigation in Mendocino County was limited to a study of those geologic features that affect recharge of ground water basins and a determination of occurrence and movement of ground water in water-bearing deposits of coastal and inland valleys. Location, extent, physical characteristics, structure, and continuity of Quaternary and Plio-Pleistocene sediments, which are the principal water-bearing deposits in the county, are presented herein. Determination of areal distribution and surface characteristics of water-bearing deposits in Mendocino County is based on geologic mapping completed during the summer and fall of 1953 and previous mapping completed by Clark (16) and Weaver (6). Subsurface characteristics of the deposits were determined by interpretation of logs of deep and shallow water wells in each area involved.

Surface distribution of geologic formations in the coastal areas and the inland valleys is shown on Plates 3 through 7. Stratigraphy and water-bearing properties of the deposits in Mendocino County are summarized in Table 6. An index of well data utilized in this investigation can be found in Table 1, Appendix A, entitled "Well Data". Location of each area and a graphic index to Plates 3 through 11 is shown on Plate 2. Detailed maps of each area and location of wells and sampling points are found on Plates 7 through 11.

Geologic Formations

Geologic formations of Mendocino County include igneous, metamorphic, and sedimentary rock types which range in age from pre-Cretaceous to Recent. In relation to occurrence of ground water, lithologic units can

TABLE 6

GEOLOGIC FORMATIONS, MENDOCINO COUNTY

Geologic Age			Group or Formation and Symbol on Plates 3 through 7	Location and Extent	General Character and Thickness	Water-Bearing Properties
Cenozoic	Quaternary	Recent	Stream Channel Deposits (Qrc)	Includes all the fine to coarse-grained materials which are presently being deposited or transported in the channels of the rivers and creeks.	Unconsolidated gravels with sand, silt and clay. The thickness varies from several inches to over 40 feet.	Coarse sands and gravels highly permeable. Silts and clays are very low in permeability.
Cenozoic	Quaternary	Recent	Sand Dune Deposits (Qd)	Includes the fine-grained eolian sands deposited close to the seacoast in the Fort Bragg and Point Arena Coastal Areas.	Unconsolidated eolian sands. Fine grained and well sorted. Sediments derived from the beaches and carried inland for a maximum distance of approximately one mile. Thickness varies from several inches to over 50 feet.	Very permeable but lack of hydrologic barriers permits underground water to escape freely into the sea.
Cenozoic	Quaternary	Recent	Alluvium (Qal)	Includes all the unconsolidated fine to coarse-grained sediments derived from the decomposition and erosion of the mountainous areas and laid down on alluvial fans of moderate slope, in creeks or river channels, on flood plains, and in lakes.	Unconsolidated gravels, sands, silts, and clays of various colors. The special conditions of deposition in each coastal area and in each locality of the inland valleys determine the nature and types of alluvial deposits. Thickness ranges from several inches to over 200 feet.	Permeability varies from extremely high in the gravels and sands to very low in the silts and clays. Yield of wells penetrating the alluvium varies from low to high depending on the type of sediments encountered.
Cenozoic	Quaternary	Recent	Older Alluvium (Qoal)	Includes all the unconsolidated, dissected older alluvial deposits. Found in the Ukiah and Hopland Valley areas.	Unconsolidated gravels, sands, silts, and clays.	Permeability varies from extremely high in the sands and gravels to very low in the silts and clays.
Cenozoic	Quaternary	Pleistocene to Recent	Non-Marine Terrace Deposits: Younger Terrace Deposits (Qty)	Includes the fine to coarse-grained terrace deposits that cover extensive areas adjacent to the alluvium in Ukiah Valley. Well developed near Talmage, Calpelle, and Coyote Valley.	Unconsolidated bouldery clays, yellow and brown clays and silts, sandy clays, sands, and gravels which were laid down as continental flood plain and fan deposits. The interbedded blue and green clays were probably deposited as lake sediments. Thickness of the Younger Terrace Deposits varies from a few feet to over 200 feet.	Yield of water wells in the Younger Terrace Deposits is low because of abundance of clay and silt in the formation.
Cenozoic	Quaternary	Pleistocene to Recent; Pleistocene	Non-Marine Terrace Deposits: Undifferentiated Terrace Deposits (Qt)	Includes all the undifferentiated unconsolidated terrace deposits of Pleistocene or Recent age. Developed in most of the inland valley areas. Usually overlie the Franciscan-Knoxville Group but in the larger valleys overlie semi-consolidated Tertiary and Quaternary sediments.	Unconsolidated gravels, sands, silts and clays. Laid down as continental flood plain and fan deposits and as lacustrine deposits. Thickness varies from several inches to over 150 feet.	Permeability varies from extremely high in the sands to very low in the silts and clays. Yield in most wells penetrating Qt is low because of the general thinness of the deposits and because of the abundance of clay and silt.

TABLE 6

GEOLOGIC FORMATIONS, MENDOCINO COUNTY

(continued)

Geologic Age			Group or Formation and Symbol on Plates 3 through 7		Location and Extent	General Character and Thickness	Water-Bearing Properties
Cenozoic	Quaternary	Pleistocene	Non-Marine Terrace Deposits	Older Terrace Deposits (Qro)	Includes the fine to coarse-grained materials of terrace deposits located in topographically higher areas than the Younger Terraces. The Older Terrace deposits occupy areas on both sides of Ukiah Valley and blanket most of the Redwood Valley area.	Older Terrace Deposits similar in lithology and thickness to the Younger Terrace Deposits. Occur in topographically higher locations than the Younger Terraces.	Yield of water wells in the Older Terrace Deposits is low due to the abundance of clay and silt in the formation.
Cenozoic	Quaternary	Pleistocene	Marine Terrace Deposits	Group I-Younger Marine Terraces (Qt1)	Includes the unconsolidated low lying marine terrace deposits adjacent to the Pacific Coast, between 50 and 250 feet in elevation. Overlie igneous, metamorphic, and sedimentary rocks along a large part of the coast line of Mendocino County.	Semi-consolidated gravels, sands, silts, and clays deposited in littoral and offshore zones of the seacoast during Pleistocene time. The basal section is usually very coarse sand, pebbles, and gravel. Deposits dissected by streams into many separate hydrologic units. Vary in thickness from several inches to over 50 feet.	Permeability varies from extremely high in sands and gravels to extremely low in silts and clays. Absence of hydrologic barriers on three sides of the terrace deposits, the average thinness, small area of the individual terrace remenants, and the presence of large amounts of silt and clay limit the storage capacity and development of appreciable amounts of ground water.
Cenozoic	Quaternary	Pleistocene	Marine Terrace Deposits	Group II-Older Marine Terraces (Qt2)	Includes the semi-consolidated marine terrace deposits located in topographically higher areas than the Group I terraces. Mapped between 250 and 500 feet in elevation.		
Cenozoic	Quaternary / Tertiary	Pleistocene / Pliocene	Plio-Pleistocene Deposits (TQ)		Undifferentiated. Includes the semi-consolidated sedimentary deposits cropping out in the low hills and extends beneath much of the alluvium in Anderson, Hopland, Little Lake, Potter, Round, Ukiah, and Willits Valleys. Beds gently to steeply tilted.	Semi-consolidated blue clays, silt, sandy and gravelly silts with interbedded sands and gravels. Laid down as continental flood plain and fan deposits with interbedded lacustrine sediments. The deposits reach a maximum thickness of over 1,000 feet in Ukiah Valley.	Permeability of the clays, silts, sands, and gravels has been decreased by consolidation and cementation. Yields to wells are very low.
Cenozoic	Tertiary	Miocene to Eocene	Point Arena Beds Gallaway Beds Schooner Gulch Basalt (T)		Undifferentiated. Consolidated sedimentary and volcanic rocks underlying the marine terraces in portions of the Point Arena Coastal Area.	Sandstones, mudstone, and diatomaceous, foraminiferal, and cherty shales. Approximately 6,300 feet in thickness.	Impervious and nonwater-bearing except along fractures and joints.
Mesozoic	Cretaceous		Gualala Series (K)		Consolidated sedimentary series underlying a large part of the Point Arena Coastal Area.	Medium to coarse-grained quartzose sandstones with thick members of clay shale. Conglomerates abundant near the base and the middle of the series. Approximately 21,000 feet in thickness.	Impervious and nonwater-bearing except along fractures and joints.
Mesozoic	Pre-Cretaceous		Undifferentiated Franciscan Group and Knoxville Formation (Jf)		Includes the consolidated sedimentary, metamorphic, and volcanic rocks that underlie the upper watershed of the northern Coast Ranges.	Consolidated graywacke, arkosic sandstones and shales with interbedded layers and lenses of radiolarian cherts, intruded by ultrabasic rocks locally altered to serpentine.	Impervious and nonwater-bearing except along fractures and joints.

be grouped into two categories. Deposits of major importance as a source of ground water include unconsolidated Recent and Pleistocene river channel, flood plain, alluvial fan, river, and marine terrace deposits, and slightly to moderately compacted continental sediments of Tertiary-Quaternary age. Deposits of minor importance as a source of ground water include the consolidated Franciscan-Knoxville group of Jurassic age, Cretaceous and Tertiary sediments and volcanics, and Quaternary sand dunes of the coastal areas.

Water-Bearing Series. Ground water in Mendocino County is stored primarily in unconsolidated Recent and Pleistocene river channel, flood plain, alluvial fan, and terrace deposits in the large inland valleys and coastal areas. Sediments were derived by decomposition and erosion of adjacent mountain areas and were laid down as alluvial fans of moderate slope, on flood plains, in creeks or river channels, on beaches, and in lakes. Limited quantities of ground water are available in unconsolidated Quaternary alluvium in numerous small intermontane valleys and in the shallow semi-consolidated coastal marine terrace deposits of Pleistocene age. Adjacent to and underlying some of the larger valleys are extensive areas of semi-consolidated water-bearing clay, silt, sand, and gravel of Tertiary-Quaternary age.

Confined ground water occurs in portions of the major inland valleys of Mendocino County. Presence of confined water is indicated by the fact that water levels in certain wells stand above the water table in the free ground water zone.

Unconsolidated Recent and Pleistocene river channel, flood plain, alluvial fan, lacustrine, and terrace deposits occur in all the major and minor intermontane valleys and in the coastal area; these deposits represent the principal areas of ground water storage in Mendocino County. They are composed of interbedded gravel, sand, silt, and clay. Special conditions of deposition in each coastal area and in each inland valley determine the nature and type of alluvial deposits. Permeability ranges from extremely high in sands and gravels to very low in silts and clays. Yield of wells penetrating alluvium depends on the type and thickness of sediments encountered. Ground water storage is probably large, but development is frequently limited by localized areas of low permeability or by thinness of deposits. Ground water has been extensively developed in the major valleys but is essentially undeveloped in the minor valleys.

Two areas of sand dune deposits of Recent age are located in the coastal area: one near the town of Fort Bragg, the other near Point Arena (Plates 5 and 6). These deposits are fine-grained, well sorted sands with a maximum thickness of over 50 feet. Lack of hydrologic barriers permits ground water to escape freely from these permeable deposits into the sea. For this reason the sand dunes are of minor significance as a ground water reservoir.

A series of river terrace deposits of late Quaternary age has been developed adjacent to the alluvium in most of the inland valleys. These terraces represent eroded remnants of ancient flood plain, alluvial fan, or lacustrine deposits laid down by ancestral streams. These deposits usually overlie the Franciscan-Knoxville group, but in the larger valleys they overlie semi-consolidated Tertiary-Quaternary sediments. They are composed of unconsolidated gravel, sand, silt, clay, and bouldery clay. These deposits vary in thickness from several inches to over 200 feet, although in general they are very thin and have been reduced by erosion to narrow remnants of small areal extent. Permeability ranges from high in sands and gravels to very low in silts and clays. Yield to wells is generally very low because of the abundance of silt and clay and the general thinness of the deposits.

Thus, the late Quaternary river terrace deposits have only local significance as a source of ground water.

Low-lying semi-consolidated marine terrace deposits of late Quaternary age overlie the igneous, metamorphic, and consolidated sedimentary rocks along most of the coastline of Mendocino County. These terrace deposits are composed of gravel, sand, silt, and clay deposited in littoral and offshore zones of the seacoast during Pleistocene time. They are generally very thin deposits, seldom exceeding 50 feet in thickness, and are dissected by streams into many separate hydrologic units. With the exception of the broad terraces near Point Arena and Fort Bragg, the deposits generally comprise only a narrow strip. The two marine terraces mapped at different topographic levels represent beach deposits laid down on a coastline that is presently being uplifted. Permeability ranges from high in the sand and gravel to very low in the silt and clay. Thinness, small areal extent, lack of hydrologic barriers on three sides of the terrace remnants, and presence of large amounts of clay and silt limit the capacity of wells and preclude development of appreciable amounts of water from the marine terrace deposits. Some ground water has been developed, however, in areas removed from sources of surface water. Ground water seepage has been noted in many areas along the contact between the terrace deposits and the underlying bedrock during the winter and spring months and during brief periods of a few days following summer rains.

Adjacent to and underlying large areas of water-bearing alluvium in the major valleys are limited areas of semi-consolidated sediments of Tertiary-Quaternary age. These sediments crop out in the low hills, are gently to steeply tilted, and extend beneath much of the alluvium in Anderson, Little Lake, Potter, Round, Sanel, and Ukiah Valleys.

These semi-consolidated deposits of blue clay, silt, and sandy and gravelly silt with interbedded sand and gravel were laid down as continental flood plain and fan deposits with interbedded lacustrine sediments. They reach a maximum thickness of over 1,000 feet in Ukiah Valley. These sediments have been affected to varying degrees by folding, faulting, and erosion during the growth of the northern Coast Range. Permeability of the clay, silt, sand, and gravel has been decreased by consolidation and cementation, and yield to wells is very low. A test well in Anderson Valley penetrating these sediments to a depth of 126 feet yielded only 4 gallons per minute (gpm) with a drawdown of 96 feet. Ground water in the Tertiary-Quaternary deposits is limited primarily to permeable sand and gravel lenses interbedded in the semi-consolidated silts and clays. Development of ground water from these deposits is very limited, and where developed, production is low.

Nonwater-Bearing Series. The nonwater-bearing series include the igneous, metamorphic, and sedimentary complex of the Franciscan-Knoxville group of Jurassic age, consolidated sediments of Cretaceous and Tertiary age, and Tertiary volcanics. Except locally, these deposits do not absorb, transmit, or yield water readily. In areas where the rocks are highly jointed or fractured, sufficient ground water may be obtained to satisfy limited needs.

The Franciscan-Knoxville group, which includes sedimentary, igneous, and metamorphic rocks, is the oldest lithologic unit identified in Mendocino County (18). This group, which underlies most of Mendocino County, is predominantly a sedimentary unit consisting mainly of thick-bedded to massive medium-grained arkosic and argillaceous sandstone and graywacke. Shale, slate, conglomerate, and chert occur in lesser amounts. The igneous rocks include intrusive serpentine, intrusive serpentinized gabbro, and basalt flows and diabase sills which have been altered to greenstone. Metamorphic rocks, including actinolite, mica, and glaucophane schists, occur as small patches in isolated areas.

Two areas of Cretaceous rocks have been mapped in Mendocino County. The first is a band of Cretaceous sandstone and shale which has been downfaulted into Franciscan rocks southwest of Round Valley (16). The second, which is separated from Franciscan rocks to the east by the San Andreas fault (6), consists of a band of quartzose sandstones, shaley sandstones, sandy shales, clay shale, and conglomerate extending along the coast from Fort Ross to Point Arena.

Two areas of consolidated Tertiary rocks have been mapped in Mendocino County. The first is a band of Eocene and Miocene sandstones, conglomerates, shales, and discontinuous coal seams, which have been downfaulted into the Franciscan rocks southwest of Round Valley (16). The second is a narrow belt of argillaceous, diatomaceous, foriminiferal, and cherty shales, mudstones, sandstone, basalt flows, and tuffaceous sandstone, which outcrop between Cretaceous sediments and the coast near Point Arena (6).

Other areas of possible outcrops of Cretaceous and Tertiary sediments in Mendocino County have been reported but have not been mapped. Mapping of such areas was beyond the scope of this investigation.

Structure

Folding and faulting have formed the dominant structural features in Mendocino County. Several major northwest-southeast trending faults traverse portions of the county. The San Andreas fault traverses the southwest coastal portion of the county and marks the boundary between Cretaceous sediments on the west and the Franciscan-Knoxville group on the east. Inland from the coast an unnamed series of major faults extends from the southern boundary of Mendocino County northwestward through or near Sanel, Ukiah, Little Lake, and Laytonville Valleys. Unnamed faults parallel Anderson Valley, extend along the Eel River north and south of Dos Rios, and bound Round Valley. In addition to these major lines of faulting, innumerable minor northwest trending faults and numerous minor cross-faults are also present. Some of the major and minor faults appear to traverse areas of ground water storage and may locally impede the movement of ground water in semi-consolidated Tertiary-Quaternary sediments and in unconsolidated alluvium. Numerous thermal springs, probably associated with faulting, contribute highly mineralized water to surface and ground waters (28).

General Water Quality

Classification of Waters

Principal beneficial uses of surface and ground waters in the county are domestic, municipal, and agricultural. Industrial uses constitute only a minor portion of total beneficial use.

In regard to domestic and municipal supplies, drinking water standards promulgated by the United States Public Health Service for water conveyed on interstate carriers are the criteria generally used to determine suitability herein. These standards, set forth in detail in Public Health Reports, Volume 61, Number 11, March 15, 1946, were voluntarily adopted January, 1946, by the American Water Works Association as the standards for all public water supplies.

Section 4.2 of the United States Public Health Service standards states that chemical substances in either natural or treated drinking water supplies should not exceed the concentrations shown in the following tabulation. This listing is by no means complete, for other organic or mineral compounds would be included if their presence in water rendered it hazardous for use.

MINERAL STANDARDS FOR DRINKING WATER
U. S. Public Health Service, 1946
(In parts per million)

Constituent	Limit
Mandatory limits	
Fluoride (F)	1.5
Lead (Pb)	0.1
Selenium (Se)	0.05
Hexavelent chromium (Cr^{+6})	0.05
Arsenic (As)	0.05
Non-mandatory but recommended limits	
Iron (Fe) and manganese (Mn) together	0.3
Magnesium (Mg)	125
Chloride (Cl)	250
Sulfate (SO_4)	250
Copper (Cu)	3.0
Zinc (Zn)	15
Phenolic compounds in terms of phenols	0.001
Dissolved solids, recommended	500
permitted	1,000

Criteria for mineral quality of irrigation water used by the Department of Water Resources are those developed at the University of California at Davis and at the Rubidoux and Regional Salinity Laboratories of the United States Department of Agriculture. Because of the diverse climatological conditions and the variation in crops and soils in California, only general limits of quality for irrigation waters can be suggested. The following broad classifications of irrigation waters are used by the Department.

"Class I EXCELLENT TO GOOD - Regarded as safe and suitable for most plants under any condition of soil or climate.

"Class II GOOD TO INJURIOUS - Regarded as possibly harmful for certain crops under certain conditions of soil or climate, particularly in the higher ranges of this class.

"Class III INJURIOUS TO UNSATISFACTORY - Regarded as probably harmful to most crops and unsatisfactory for all but the most tolerant.

"Tentative standards for irrigation water have taken into account four factors or constituents, as listed below."

QUALITATIVE CLASSIFICATION
OF IRRIGATION WATERS

Factor	Class I Excellent to good	Class II Good to injurious	Class III Injurious to unsatisfactory
Conductance $EC \times 10^6$ at 25°C	Less than 1,000	1,000 - 3,000	More than 3,000
Boron in ppm	Less than 0.5	0.5 - 2.0	More than 2.0
Sodium in per cent of base constituents	Less than 60	60 - 75	More than 75
Chloride ion concentration in ppm	Less than 175	175 - 350	More than 350

No attempt has been made in this report to classify waters for industrial uses, since many types of industry have specific quality requirements. Water used for industrial purposes in Mendocino County represents only a minor portion of the total beneficial use.

While hardness is of significance in domestic and municipal supplies as well as for industrial uses because of economic and aesthetic considerations, it is not considered in this report as a determining criterion in judging the suitability of waters for beneficial purposes. Hardness can readily be removed or decreased to acceptable limits. Waters containing 55 parts per million (ppm) or less of hardness (expressed as $CaCO_3$) are considered as "soft" herein; those containing from 56 to 100 ppm are "slightly hard"; those containing from 101 to 200 ppm are termed "moderately hard"; and those with more than 200 ppm are called "very hard".

Iron concentrations commonly present in Mendocino County waters are of significance for domestic, municipal, and industrial supplies. Iron may be removed by aeration and filtration. Such treatment is practical for municipal and industrial supplies but does not lend itself readily to individual supplies. Thus iron concentrations must be considered when determining the suitability of water for beneficial uses.

Terms used herein to describe the chemical character of water are definitive. A magnesium bicarbonate water, for example is a water in which the magnesium ion is equal to or greater than 50 per cent of the cations and bicarbonate is equal to or greater than 50 per cent of the anions measured in equivalents per million (epm). A magnesium-calcium bicarbonate water is one in which magnesium is more abundant than calcium but is less than 50 per cent of the total cations, and a magnesium-bicarbonate-chloride water is one in which bicarbonate exceeds chloride but is less than 50 per cent of the total anions.

Surface Water

Surface water of Mendocino County is generally of excellent mineral quality and is suitable for most beneficial uses. Total solids are generally less than 175 ppm. Calcium and magnesium are normally the major cation constituents. Sodium is generally present in lesser concentrations, whereas potassium is normally present in negligible concentrations. Bicarbonate is the principal anion constituent; chlorides and sulfates are present in minor concentrations, while fluoride and nitrate concentrations are negligible. Boron is normally present in minor quantities, although a number of isolated areas boron is present in appreciable concentrations.

Some minor streams throughout the county contain highly mineralized waters during periods of low flow. These streams derive part of their low flow supply from juvenile or deep seated waters migrating to the surface through fault zones, fractures, or joints in the Franciscan formation.

Mineral analyses of surface waters of Mendocino County are shown in Table 2, Appendix A.

Ground Water

Ground water of Mendocino County is normally of excellent mineral quality suitable for most beneficial uses. However, in some areas iron is present in sufficient concentration to render it undesirable for domestic and some industrial uses without treatment. Ground water generally contains less than 200 ppm total solids. Calcium and magnesium are normally the major cation constituents. Sodium is generally present in moderate concentrations, whereas potassium is present in negligible concentrations. Bicarbonate is the principal anion constituent. Chlorides, sulfates, and nitrates are in lesser concentrations, and fluoride concentrations are negligible. In many locations boron is present in sufficient concentrations to affect the suitability of water for irrigation purposes.

There are minor areas of poor quality ground water throughout the county.

Mineral analyses of ground waters of Mendocino County are shown in Table 3, Appendix A.

Anderson Valley

Anderson Valley is located in the south central portion of Mendocino County midway between the coast and Russian River. The location is indicated on Plate 2, areal geology is found on Plate 3, and location of wells and sampling points is shown on Plate 8. The valley, an alluvial area comprising 7.9 square miles, is oriented in a northwest direction. Length averages 10 miles, and width averages 0.8 mile. Elevation of the valley floor ranges from 480 feet at the southeast end to 200 feet at the northwest end.

The economy of Anderson Valley is based upon logging, lumber processing, and agriculture. Livestock and fruit are the major agricultural products. Much of the land on the valley floor is devoted to hay and pasture.

Two communities, Philo and Boonville, are located in the valley. Philo is located in the central portion of the valley, and Boonville is situated in the southeast portion.

State Highway 128 from Cloverdale traverses the length of the valley, passes through Boonville and Philo, and parallels Navarro River to the coast. The area is also served by county roads from Ukiah to Point Arena areas.

Only a small portion of the irrigation requirements in the valley is supplied from surface water. A minor quantity of surface water is used to fill and maintain sawmill ponds in the area. Due to type of crops and lack of surface water during critical months, the major portion of irrigation requirements and all of the domestic requirements are met by ground water.

Surface Water Hydrology

The nearest precipitation station is at Yorkville, which is outside the limits of the valley and is 12 miles southeast of Boonville. Fifteen years of record at this station show an average annual precipitation of 47.64 inches (Table 1). Because of proximity to the Pacific Ocean and influence of local topography on precipitation in the area, the record at Yorkville serves only as an indicator of the magnitude of precipitation in Anderson Valley.

Anderson Creek and its tributaries drain the eastern half of the valley. Anderson Creek and Rancheria Creek, which drains a large area adjacent to the valley, converge approximately a half mile south of Philo. The combined stream forms the Navarro River downstream from the point of confluence. The western half of the valley is drained by the Navarro River and minor tributaries. Navarro River flows into the ocean approximately 20 miles northwest of Boonville. A stream flow record from a gaging station near Navarro, which lies just above the mouth and 20 miles west of Anderson Valley, shows an average discharge of 657 cfs for the four years of record from 1950 to 1953 (Table 3).

Waters of Navarro River and Anderson Creek are derived from ground water and surface runoff from a large forest area adjacent to the valley. These streams normally sustain perennial flow, at least in the lower reaches.

During winter months flows of large magnitude caused by surface runoff of direct precipitation frequently inundate adjacent lands. Flows in the minor tributaries during summer months are primarily derived from springs at the edge of the valley. These flows are generally not of sufficient magnitude to reach Anderson Creek or Navarro River because of percolation and evapo-transpiration losses enroute.

Ground Water Geology and Hydrology

There are no continuous or extensive aquifers in Anderson Valley. In relation to occurrence of ground water, lithologic units can be grouped into three categories. The deposits of major importance as a source of ground water are Recent alluvium, river channel deposits, and terrace deposits. Deposits of secondary importance as a source of ground water are semiconsolidated sediments of late Tertiary or early Pleistocene age. The Franciscan formation which underlies the entire area is considered essentially nonwater-bearing. However, limited amounts of water are produced from joints and fractures in this formation by a few springs and wells around the periphery of the valley. In addition water stored in these rocks is a minor source of supply to several streams.

Recent Alluvium, River Channel Deposits, and Terrace Deposits. Recent alluvium and river channel deposits consist of loose, unconsolidated gravel, sand, silt, and clay. Alluvium and river channel deposits range in thickness from a very thin veneer to sections over 20 feet thick. They are generally limited to the topographically low areas adjacent to streams. Alluvial fans were recognized at the mouths of several of the smaller canyons but were of such limited areal extent as to be unrecordable at the map scale used in the field investigation. Permeability ranges from high in the river gravel to very low in the silt and clay.

Terrace deposits of Recent and Pleistocene age were laid down as continental flood plain and fan deposits. Bouldery yellow clay, silt, sandy clay, sand, and gravel of the flood plain and fan deposits are interbedded with blue and green clays which were probably deposited as lake sediments. Thickness of terraced deposits ranges from approximately 5 to over 150 feet near Boonville. An abundance of silt and clay exists in these deposits. The following composite log of wells northwest of Boonville is typical of material comprising these terraced sediments.

Depth in feet	Material	Depth in feet	Material
0 - 5	Surface soil	45 - 65	Blue clay with streaks of gravel
5 - 20	Gravel with yellow clay	65 - 120	Sandy blue clay with streaks of gravel and some old wood
20 - 30	Boulders and gravel	120 - 125	Gray sand
30 - 40	Yellow clay	125 - 130	Gravel and clay
40 - 45	Blue clay		

Abundance of boulders in these deposits indicates considerable relief and intermittent heavy rains at the time of deposition. The blue and green clays indicate deposition in recurrent lakes probably formed when the valley outlets were dammed at irregular intervals. Subsequent downcutting by rejuvenated streams removed only a portion of these sediments, thus leaving the remainder as terraces.

Terrace deposits underlie Recent alluvium along that portion of Anderson Valley drained by Anderson Creek and unconformably overlie Tertiary-Quaternary sediments. Exposures are extensive but discontinuous.

Ability of alluvium and terrace deposits to store, transmit, and yield ground water is limited because of the large proportion of silt and clay and because of the lenticularity of the more permeable zones. Because of their widespread areal and vertical extent, however, these deposits represent the most important source of ground water storage in Anderson Valley. They include many lenses of permeable material which ordinarily would yield appreciable quantities of ground water but which are reportedly dry because of lack of connection with possible sources of recharge.

Ground water yields to wells range from 5 to 300 gpm and average 10 to 50 gpm with drawdowns commonly in excess of 70 feet. Consequently, specific capacities average 0.1 to 0.7 gpm per foot of drawdown with isolated values to 5 gpm per foot of drawdown. The higher yields occur in terrace deposits because of greater vertical extent of water bearing materials, but the higher specific capacities occur in alluvial and river channel deposits with somewhat higher permeability.

The depth to water in the alluvium and river channel deposits varies from 0 to 30 feet, whereas in the terrace material it varies from 10 to 60 feet. Water level measurements indicate little similarity of depth to ground water between adjacent wells, a possible effect of lenticularity of the underlying material and consequent localized pressure effects or of complete lack of hydraulic connection between permeable zones. Ground water stored in recent alluvium and river channel deposits generally lie in direct hydraulic continuity with surface streams. Near the main stems of surface streams ground water fluctuations are generally small, whereas near smaller creeks, because they do not sustain perennially flow, the fluctuations are considerable. A pressure zone exists in a small area in the vicinity of Boonville. Ground water is confined at depths ranging from 75 to 100 feet, and the piezometric surface varies from 30 to 50 feet above the level of the confining beds and from 10 to 20 feet above levels in surrounding wells.

Ground water generally moves in a northwest direction along the axis of the valley, whereas along the flanks it moves toward the axis of the valley. At the lower end of the valley ground water levels are normally above the level of the river channel. In this area appearances indicate appreciable rising water in Navarro River.

Ground water in these deposits is recharged by direct infiltration of precipitation and unconsumed irrigation waters, percolation from surface streams in forebay areas of alluvial fans, and infiltration from water stored in fractures of underlying rocks.

Tertiary-Quaternary Sediments. These sediments are composed of interbedded clay, sand, and gravel laid down as continental flood plain and fan deposits with interbedded lacustrine sediments. Their age is thought to be Pliocene or early Pleistocene. This formation outcrops in the low hills in the vicinity of Philo, where it appears to be over 200 feet thick. Deformation and erosion have reduced the formation to discontinuous remnants. These deposits have undergone considerable consolidation and cementation.

Permeability of these deposits is very low and therefore their importance as a ground water source is minor. Several wells penetrating this formation supply sufficient water for limited use. Recharge to these deposits occurs from infiltration of precipitation in outcrop areas and from percolation from younger sediments where they overlie these deposits.

Water Quality

Surface water of the area is generally of excellent mineral quality, suitable for all present beneficial uses. Mineral analyses of surface waters from this area are shown in Table 2, Appendix A. Surface water is characteristically calcium-magnesium bicarbonate. Total solids are low and range from 139 to 211 ppm. Boron is present in negligible concentrations, except in water of Soda Creek, tributary to Anderson Creek just north of Boonville, which contains approximately 1.0 ppm.

Soda Creek receives a portion of its supply from a spring near the headwaters of the creek. These waters are probably derived in part from juvenile or deep-seated waters rising along fault zones or fractures in the underlying rock and from entrapped mineralized waters common in the Franciscan formation.

With the exception of significant iron concentrations, ground water underlying the valley area is generally of excellent mineral quality and is suitable for most beneficial uses. Mineral analyses of ground waters are shown in Table 3, Appendix A. The ground water is characteristically calcium-magnesium bicarbonate. Total solids are low, ranging from 99 to 380 ppm.

Three types of ground water have been identified in the area. The first type is the normal undegraded water which predominates throughout the valley. This water is characteristically calcium-magnesium bicarbonate and is very similar to normal surface waters in the area. However, this water contains appreciable quantities of iron and manganese which render it objectionable for domestic purposes.

The other two types of water exhibit evidence of derivation in part from either juvenile or deep-seated waters probably rising along fault zones. One is a sodium bicarbonate water such as that indicated by a mineral analysis from well 14N/14W-34G6. This analysis shows a high concentration of boron and a moderate chloride concentration. Sulfate concentration is negligible. Total solids are 380 ppm. A mineral analysis of water from well 14N/15W-2Q1 exemplifes the other type of degraded ground water. This analysis shows a magnesium-sodium bicarbonate-sulfate type with total solids of 292 ppm and appreciable concentration of iron. Boron is present in minor concentrations. This water appears to have been considerably diluted by normal ground water.

Poor quality water found in this area apparently occurs as isolated deep seated or entrapped mineralized waters rising along fractures or joints in the underlying bedrock. While no extensive continuous aquifers exist, the normal good quality water present in the valley should be protected from sources of poor quality water. Wells which tap this poor quality water should be sealed or reconstructed, and new wells should be designed to eliminate the possibility of poor quality water commingling with the normal undegraded water.

Sanel Valley

Sanel Valley, an irregularly shaped alluvial area, is located in the southeast section of Mendocino County approximately 14 miles south of Ukiah. Its location within Mendocino County is shown on Plate 2, areal geology is illustrated on Plate 3, and locations of wells and sampling points are shown on Plate 8. Alluvial portions of the valley cover an area of approximately 11.5 square miles. Valley floor elevations range from 460 feet at the south end to 530 feet at the north end.

Hopland and East Hopland, both located in the central portion of the valley, are population centers. U. S. Highway 101 and the Northwestern Pacific Railroad traverse the valley from north to south. Secondary roads which serve the valley include East River Road to Ukiah, Lakeport Road, and Boonville Road.

Sanel Valley is primarily devoted to agriculture. Hops, fruits, hay, and grain are the principal products.

Domestic water supplies for the area are derived from ground water. A public utility district furnishes the supply for the town of Hopland, whereas ground water from individual wells supplies the remainder of domestic requirements for the valley.

Adjacent to the Russian River many of the irrigation requirements are furnished by direct diversion from the river. Irrigation supplies for the remainder of the valley are met almost exclusively by ground water.

Surface Water Hydrology

The meteorological station in Sanel Valley is located at Largo Station, two miles south of Hopland. Sixteen years of record at this station show an average annual precipitation of 38.68 inches (Table 1).

Russian River, the only perennial stream in the area, traverses Sanel Valley from north to south. It receives the drainage from 362 square miles above the gage at the north end of the valley and receives an average of approximately 197 cfs of water imported from the Eel River via Potter Valley Powerhouse. Records from the United States Geological Survey gaging station on the Russian River at the north end of the valley show an average stream flow of 684 cfs for 14 years of record (29). Flows in the summer months frequently drop below 100 cfs, and winter flows commonly exceed 5,000 cfs. Streams which drain into the Russian River within Sanel Valley watershed are intermittent in nature and flow only during the winter and spring seasons. These include McDowell and Feliz Creeks.

Ground Water Geology and Hydrology

Sanel Valley is underlain by consolidated rocks of the Franciscan formation which outcrop in the surrounding hills and mountains.

Lithologic units can be grouped into three categories. Deposits of major importance as a source of ground water include Recent alluvium, river channel deposits, and terrace deposits. Deposits of secondary importance include semi-consolidated clay, sand, and gravel of Tertiary-Quaternary age. Deposits of negligible importance as a source of ground water are the sedimentary and metamorphic rock units of the Franciscan group.

Recent Alluvium, River Channel Deposits, and Terrace Deposits.

Recent alluvium consists of loose, unconsolidated gravel, sand, silt, and clay laid down principally as river channel and flood deposits. The alluvium and river channel deposits range in thickness from a very thin veneer only a few inches thick to sections over 75 feet thick. Information from well logs indicates that the alluvium consists of interbedded yellow and blue clay, brown and gray sand, and gravel.

Terrace deposits are made up of gravel, sand, silt, and clay laid down as fan deposits. They are moderately dissected as a result of recent erosion. Only small remnants of the terrace deposits remain in Sanel Valley; these vary in thickness from a few inches to approximately 20 feet. These deposits do not yield ground water readily because of the abundance of silt and clay and the thinness of the deposits.

Ground water in Sanel Valley occurs in interconnected lenses of sand and gravel throughout the valley and in the coarse river channel deposits adjacent to Russian River. These latter deposits are extremely porous and store, transmit, and yield water readily. Permeability of alluvium in flood plain deposits in the center of the valley ranges from extremely high to very low. These deposits are composed of interbedded lenses of clay, sand, and gravel.

Yields to wells range from 750 to 1,250 gpm with drawdowns averaging 25 to 30 feet in the alluvium and channel deposits adjacent to Russian River. In the terrace deposits yields range from 5 to 50 gpm with drawdowns as high as 50 feet. Specific capacities thus range from 50 gpm per foot of drawdown in the more permeable sediments to 0.1 gpm per foot of drawdown in the less permeable terrace deposits.

Depths to ground water vary from 0 feet near the river to 25 feet in higher portions of the Valley.

Recharge to ground water is accomplished in three ways. The major portion of recharge is comprised of percolation from surface streams and of direct infiltration of precipitation and unconsumed irrigation water. Recharge to the alluvium may occur from water stored in joints and fractures of consolidated rocks.

Tertiary-Quaternary Sediments. This formation is composed of interbedded clay, silt, sand, and gravel laid down as continental flood plain and fan deposits interbedded with lacustrine sediments. The age of these beds is thought to be Pliocene or early Pleistocene. Deformation and erosion have reduced the formation to two small outcrop areas in the hills northeast and southeast of East Hopland, where the formation appears to be over 200 feet thick.

Permeability of the Tertiary-Quaternary sediments have been decreased by consolidation and cementation. Some wells yield water from this formation.

Water Quality

With the exception of relatively high boron concentration during summer and fall, water flowing in Russian River in this area is normally of excellent mineral quality and is generally suitable for most present beneficial uses. Mineral analyses of Russian River water are contained in Table 2, Appendix A. It is characteristically a calcium bicarbonate type with total solids ranging from 108 to 125 ppm and boron concentrations ranging from 0.2 to 1.5 ppm.

Concentration of boron fluctuates with flow. Concentrations are higher during periods of low flow due to local inflow containing appreciable boron. Several small tributaries to Russian River above Sanel Valley contain high boron concentrations and apparently derive a portion of their flow from juvenile and/or connate waters rising along fault zones. Dilution is least effective during low flow periods. With the exception of boron, mineral solubles in the tributaries are not present in sufficient quantity to materially affect the quality of Russian River. During low flows, however, concentrations of boron in Russian River approach the concentration tolerated only by more resistant plants.

Ground water underlying the valley area is of good mineral quality and suitable for most beneficial uses. This water is characteristically a magnesium-calcium bicarbonate type with total solids ranging from 143 to 327 ppm as shown in the mineral analyses in Table 3, Appendix A. However, ground water of the area may contain appreciable quantities of iron which would render it objectionable for domestic and some industrial purposes. The presence of boron suggests that ground water is derived in appreciable quantities in several wells in part from juvenile and/or connate waters rising along fault zones or fractures in the underlying bedrock.

Water from wells 13N/11W-18Q1, 20C1, and 21L1 contain higher concentrations of sodium, chloride, and boron than do the remaining wells. As indicated on Plate 8, these three wells lie roughly in a straight line near East Hopland. The higher concentrations of sodium, chloride, and boron suggest derivation from mineralized water rising along a fault zone or fracture.

Wells have been drilled approximately two miles north of Hopland on the east bank of Russian River for production of carbon dioxide gas. During the course of the original field investigation, no wells were in production. During the summer of 1954, several wells were drilled to a depth of approximately 1,100 feet. These wells produced carbon dioxide gas and water with an artesian head of approximately 90 feet and a temperature of 140° F. A water sample from these wells showed magnesium bicarbonate water with magnesium concentration of 1,330 ppm, sodium of 1,020 ppm, bicarbonate of 4,130 ppm, and chloride of 1,220 ppm. Total solids were 6,170 ppm. Boron concentrations ranged from 404 to 690 ppm as shown in the analyses in Table 3, Appendix A. Carbon dioxide gas has also been observed in a number of shallower wells in the surrounding area and in seeps near the carbon dioxide gas wells. Additional abandoned carbon dioxide gas wells are located in the immediate area of those drilled in 1954. Due to the corrosive effect of the water, the temperature, and the pressure, it is highly possible that the casings of some of the abandoned gas wells have failed and that usable ground waters are being degraded by mineralized waters from this source. At present there is no production from these gas wells.

In view of the number of wells throughout the area which produce water with relatively high boron concentrations, it is necessary to construct wells in a manner that will eliminate the threat of degradation of usable ground water by poor quality water. When water of poor quality is found, every effort should be made to construct or reconstruct the wells to prevent such water from commingling with usable supplies.

Laytonville Valley

Laytonville Valley (known locally as Long Valley) is located in the north central portion of Mendocino County approximately 45 miles north of Ukiah. The location is indicated on Plate 2, areal geology on Plate 4, and locations of wells and sampling points on Plate 9. The valley is a structural depression containing an alluvial area of 11.7 square miles. Length averages 9 miles and width averages 1.3 miles. Elevation of the valley floor varies between 1,630 feet at the southern end and 1,685 feet in the central portion.

Income in Laytonville Valley is derived from logging, lumber processing, and agriculture. Cattle and sheep comprise the major agricultural products.

The town of Laytonville, the only community in the area, is situated on the east edge of the valley at the junction of U. S. Highway 101, Branscomb Road, and Dos Rios Road.

Laytonville Valley is served by U. S. Highway 101, which traverses from north to south, and by secondary roads to the coast and to Round Valley.

Municipal water supply for Laytonville and individual domestic supplies for the remainder of the valley are derived entirely from ground water. Water for irrigation of pastures and hay crops is drawn primarily from wells, although surface streams satisfy a small portion of the irrigation requirements, particularly during the late spring and early summer months.

Surface Water Hydrology

Precipitation at Laytonville has averaged 56.20 inches for 15 years of record (Table 1). Less than two per cent of the rainfall occurs during the months of May through September. The average precipitation is greater than that which occurs in the other major valleys. It is affected by the northerly location of the valley and the surrounding mountainous terrain, particularly that which lies east of the valley.

A topographic divide occurs near the south end of the valley and gives rise to two stream systems, one flowing north, the other south. Short-term miscellaneous stream flow records are available for some of the streams draining the area.

Ten Mile Creek and its minor tributaries drain all but the extreme southern portion of the valley. This stream rises in mountains southeast of the valley, moves north through the central portion, and leaves at the extreme northern end. It then turns sharply west and enters the South Fork of Eel River approximately five miles west of the valley. Long Valley Creek drains the extreme southern end of the valley and converges with Outlet Creek approximately eight miles south of the valley.

Ten Mile Creek usually has no flow during July, August, and early September, although pools of stagnant water exist throughout the summer. The portion of Long Valley Creek within Laytonville Valley ceases to flow following spring rains and has no flow until fall rains begin.

The area is not usually subjected to severe floods due to small drainage areas and the comparatively great flow capacity of the entrenched streams.

Ground Water Geology and Hydrology

Laytonville Valley is a structural depression in the bedrock which has been filled, in part, with alluvial sediments washed into the valley from adjacent hills. Several separate and distinct alluvial areas lie within this structural depression and function as hydraulically independent basins. The main ground water basin occupies the southern two-thirds of the valley floor as shown on Plate 4, and an alluvial area of secondary importance occupies the northern one-third. An alluvial area of minor importance occurs approximately four miles southwest of Laytonville.

The lithologic units can be grouped into two categories. The deposits of major importance as a source of ground water include the Pleistocene terrace deposits and Recent alluvium. Deposits of minor importance as a source of ground water are the sedimentary and metamorphic rock units of the Franciscan group of Jurassic age. A few shallow wells west of Laytonville produce minor amounts of water from joints and fractures in this formation.

Recent alluvium and river channel deposits consist of loose, unconsolidated gravel, sand, silt, and clay. Alluvium and river channel deposits range in thickness from a very thin veneer a few inches thick to sections as thick as 300 feet. As shown on Plate 4, alluvium and river channel deposits are found in the topographically low areas adjacent to streams as well as in small isolated valleys near Laytonville Valley. Alluvium is thickest in the structural trough west of Laytonville. Alluvium and older deposits attain a maximum thickness of over 300 feet just west of Laytonville but decrease rapidly in thickness to the north and more slowly to the south. Two and one-half miles south of Laytonville the unconsolidated deposits are 150 feet deep, and 3.5 miles south the deposits are about 50 feet in depth. The structural trough slopes rapidly upward to the east, and the western boundary shows evidence of being formed by a fault. Topographic evidence of this fault was noted during the field investigation. Wells just west of the fault penetrate a maximum of 50 feet of alluvial material before reaching bedrock, whereas those immediately to the east penetrate over 300 feet of alluvial material before reaching bedrock.

A composite log follows which indicates typical lithology commonly encountered during drilling of wells in the thick section of unconsolidated sediments near Laytonville.

Depth in feet	Material	Depth in feet	Material
0 - 10	Surface soil	140 - 170	Hard brown clay and large gravel
10 - 35	Yellow sand and rubble	170 - 190	Pea gravel
35 - 40	Blue sandy clay	190 - 220	Blue clay
40 - 60	Yellow clay and gravel	220 - 250	Green sand
60 - 80	Sand and gravel	250 - 280	Blue clay and green sand
80 - 110	Cemented gravel	280 - 320	Blue clay
110 - 130	Hard clay	320 - 350	Consolidated bedrock
130 - 140	Cemented gravel		

Terrace deposits of Recent and Pleistocene age include gravel, sand, silt, and clay laid down as continental flood plain and fan deposits. Subsequent erosion has reduced the once extensive areas of continental sediment to terrace remnants on the flats west of Laytonville. Thickness of the terrace deposits ranges from a few inches to 50 feet. Well logs indicate that deposits are generally thin and are underlain by Franciscan bedrock.

Permeability ranges from moderate in the alluvium and river channel deposits to low in the terrace deposits. Yields to wells along the axis of the valley range from 25 gpm for shallower wells to a maximum of 700 gpm for wells over 250 feet deep. Yields to wells producing only from terrace deposits west and north of Laytonville are low because of thinness of the deposits.

In the main ground water basin, water levels range from artesian conditions to 40 feet below ground surface. Due to lenticularity of material and associated localized pressure effects or to complete lack of hydraulic continuity, there appears to be little or no similarity between water levels in adjacent wells. Localized pressure conditions exist throughout the structural trough extending through Laytonville. Between spring and late fall the water level fluctuates approximately 10 feet. Lenticularity of the sediments impedes movement of ground water in the alluvium.

Recharge to ground water occurs principally from percolation of precipitation and of stream flow, although a minor amount is contributed by water stored in fractures and joints of the normally consolidated Franciscan formations. Recharge to ground water from the principal sources occurs only during winter and spring months due to concentration of precipitation and resulting surface runoff during that period. Streams are normally dry during summer and early fall months. Complete dependence on ground water for all water supplies during this period and lack of recharge cause the fluctuation of ground water levels previously mentioned.

Along the axis of the valley recharge to ground water in terraces and to shallow ground water occurs from percolation of precipitation, stream flow, and irrigation return water. Recharge to deeper water in the pressure zone along the axis of the valley occurs in forebay areas along the edges of the valley.

The alluvial area north of the main basin, which is shown on Plate 4, serves as a source of ground water supply of minor importance. This area is composed of relatively thin alluvium and terrace deposits. There are only three wells known to have been drilled in this area (Plate 9). Depths to water are shallow ranging from 10 to 20 feet, but yields are low because of relatively low permeability and thinness of the deposits. Recharge occurs from percolation of precipitation along the edges of the valley and percolation from Ten Mile Creek during winter and spring months.

Water Quality

Surface water in Laytonville Valley, with the exception of Sulphur Springs Creek, is of excellent mineral quality and is suitable for all present beneficial uses. Mineral analyses of surface water are contained in Table 2, Appendix A. These waters are generally calcium-magnesium bicarbonate in character. With one exception total solids are low, ranging from 66 to 132 ppm.

Sulphur Springs Creek, which flows into Ten Mile Creek in the east central portion of the valley, shows a sodium chloride type water with total solids of 918 ppm. Boron concentration is 16 ppm. This creek receives its entire dry weather flow from a spring. The mineral composition of 246 ppm sodium, 395 ppm chloride, and high boron suggests a juvenile or deep seated water rising along a fault or fracture in the underlying bedrock.

Lewis Creek, which flows into Ten Mile Creek in the north end of the valley shows a calcium bicarbonate water with total solids of 132 ppm and a boron concentration of 0.39 ppm. This water suggests a mixture of the natural calcium-magnesium bicarbonate water with mineralized water rising along a fault or through fractures in the underlying rock.

Below its confluence with Sulphur Spring Creek, Ten Mile Creek shows the effect of the flow from Sulphur Springs Creek. This water is a calcium-sodium bicarbonate water with total solids of 114 ppm. Boron concentration is 0.53 ppm.

Ground water of Laytonville Valley is generally of excellent mineral quality, suitable for most present beneficial uses. It is primarily a calcium-sodium bicarbonate water with total solids ranging from 56 to 472 ppm. Boron concentrations range from 0.04 to 9.8 ppm and are generally less than 0.15 ppm. Mineral analyses of ground water are shown in Table 3, Appendix A. Well 21N/15W-12C2 which shows a boron concentration of 9.8 ppm is 40 feet deep and yields a sodium bicarbonate water. This well apparently derives its supply primarily from nearby Sulphur Springs Creek which has a boron concentration of 16 ppm and yields a sodium bicarbonate water. This well apparently derives its supply primarily from nearby Sulphur Springs Creek which has a boron concentration of 16 ppm and yields a sodium chloride water. Well 21N/15W-12C1 which is 140 feet deep and lies only a short distance from well 21N/15W-12C2 yields a calcium bicarbonate water with a boron concentrarion of 0.22 ppm. This well penetrates the pressure aquifer which exists in the trough along the east side of the valley and does not derive its supply from the same source as well 21N/15W-12C2. Sampling points are indicated on Plate 9.

Water contained in the pressure zone along the axis of the valley is generally of excellent quality and should be protected from degradation by overlying waters of poor quality such as those existing in Sulphur Springs Creek and those reflected in well 21N/15W-12C2.

Well construction must be suitable to prevent waste of artesian water as provided by law (Sections 300-311 of the Water Code).

Little Lake Valley

Little Lake Valley is located in the central portion of Mendocino County approximately 22 miles north of Ukiah. Its location is indicated on Plate 2, areal geology on Plate 4, and locations of wells and sampling points on Plate 9. Approximately 2.5 miles wide and 7.5 miles long the valley is an irregular oval basin formed by folding and faulting of the Coast Range and contains approximately 17.4 square miles of alluvial land. Elevations on the valley floor range from 1,350 feet at the north end to 1,600 feet at the south end.

Income in Little Lake Valley is derived primarily from lumbering, agriculture, and tourist services. Lumber, sheep, cattle, and cereals are the principal products.

Willits, a town of 2,700 population located in the west-central section of the valley, is the largest town in the area and the third largest town in the county. Approximately 5,300 persons live in or adjacent to Little Lake Valley.

Little Lake Valley is served by U. S. Highway 101, Fort Bragg and Hearst Roads, the Northwestern Pacific Railroad, and the California Western Railroad and Navigation Company.

Municipal water supply for Willits is obtained from Morris Reservoir on Davis Creek. Domestic supplies for the remainder of the valley are obtained from individual wells and springs. Irrigation requirements are met by both ground and surface water, although ground water is the major source of supply.

Surface Water Hydrology

The records of the meteorological station located near Willits indicate an average annual precipitation of 50.07 inches during the 68-year period from 1888 to 1955 (Table 1).

No major streams pass through the valley. Numerous small streams including Willits, Broaddus, Haehl, Davis, Baechtel, and Berry Creeks drain the south and central area of the valley and discharge into a swamp area in the north portion of the valley. The swamp area is created by inability of ground and surface water to escape freely from the valley because of bedrock at the north end. Outlet Creek has its origin in rising waters at the extreme north end.

Most of the smaller creeks do not sustain perennial flow; Outlet Creek with its source in the swamp area, however, normally flows throughout the year.

Since the stream system encompasses a small area and is well developed, winter rains do not cause severe flooding. However, during the winter when runoff exceeds the capacity of the valley outlet, water occasionally ponds in the swamp at the north end of the valley.

Ground Water Geology and Hydrology

Little Lake Valley was formed as a structural basin during the folding and faulting of the northern Coast Range which began in later Tertiary and continued well into Pleistocene time. The valley is somewhat saucer shaped and is filled with a great thickness of alluvial sediments which provides storage for a large volume of ground water.

Lithologic units can be grouped into two categories. Deposits of major importance as a source of ground water include Recent alluvium, river channel deposits, and semi-consolidated clay, sand, and gravel of late Tertiary and early Pleistocene age. Deposits of minor importance as a source of ground water are sedimentary and metamorphic rock units of the Franciscan group of Jurassic age which underlie the entire area. A number of springs which produce minor quantities of water from joints and fractures have been developed in this formation, particularly along the northeast side of the valley.

River channel deposits were found as thin veneers of gravel and sand along Davis Creek near the south central portion of the valley and along Outlet Creek near the valley outlet. Deposits range in thickness from a few inches to approximately 20 feet and are very permeable, but they are of minor importance as a source of ground water because of limited areal extent.

Recent alluvium consists of unconsolidated gravel, sand, silt, and clay. These sediments were derived by decomposition and erosion of mountain areas adjacent to the valley and were laid down on alluvial fans of moderate slope, in creek or river channels, on flood plains, and in lakes. As shown on Plate 4, alluvium occupies the entire central and northern portions of Little Lake Valley. Alluvium ranges from a thickness of a few inches to an unknown thickness of over 250 feet near the center of the valley.

A composite log of the alluvium and older sediments follows:

Depth in feet	Material	Depth in feet	Material
0 - 2	Top soil	190 - 195	Blue clay and boulders
2 - 15	Yellow clay, gravel, and fine sand	195 - 215	Yellow clay and gravel
15 - 35	Yellow clay, gravel, and coarse sand	215 - 240	Blue clay and gravel
35 - 40	Sticky blue clay	240 - 250	Blue clay
40 - 60	Blue clay	250 - 260	Yellow clay
60 - 65	Blue clay and gravel	260 - 285	Blue clay
65 - 80	Blue clay	285 - 290	Yellow sand and gravel
80 - 85	Blue clay and gravel	290 - 320	Coarse blue sand
85 - 100	Coarse gravel	320 - 345	Coarse brown sand
100 - 125	Blue cemented gravel	345 - 350	Coarse gray sand
125 - 150	Blue clay	350 - 360	Coarse multi-colored sand
150 - 160	Yellow clay and gravel	360 - 370	Yellow sandy clay
160 - 175	Blue clay	370 - 410	Blue clay
175 - 190	Sand and gravel	410 - 430	Coarse brown sand
		430 - 445	Brown sandy clay and gravel
		445 - 455	Blue clay and gravel

Tertiary-Quaternary sediments are composed of interbedded clay, silt, sand, and gravel laid down as continental flood plain and fan deposits and lake sediments. Blue clay and silt contain abundant organic remains in the form of diatoms and carbonized wood fragments. The age of these beds is thought to be Pliocene or early Pleistocene. This formation outcrops in the low hills which extend into the valley from the southwest margin, in the hills which form the south end of the valley where it is over 300 feet thick, and in hills on the east edge of the valley. The formation also is exposed in some stream channels near the south end of the valley. It extends to an unknown depth beneath the alluvium. The irregular outline is due to erosion and to subsequent alluviation of the valley.

The lenticularity and partial lack of hydraulic connection in the water-bearing sediments of the central and northern portions of the valley are illustrated by the variance in water levels. Individual wells frequently penetrate several lenses, thus providing means for interchange of water from one lens to another. In certain areas, especially during winter months, some wells flow above ground surface; a lack of similar artesian flow from adjacent wells indicates the presence of isolated pressure zones. Water levels in the valley range from artesian flows above ground to depths of 40 feet.

Movement of ground water within these formations is impeded by the abundance of silt and clay and by lenticularity of the more permeable zones. In addition movement of ground water within the Plio-Pleistocene sediments may be impeded by faults.

Recharge to the basin occurs primarily from percolation of stream flow and of precipitation, particularly in the forebay areas. Although some recharge occurs from infiltration on the valley floor, the amount is limited by the abundance of silt and clay.

Water Quality

Mineral analyses of surface waters in Little Lake Valley, contained in Table 2, Appendix A, indicate that with the exception of some iron, the surface water is of excellent mineral quality and is suitable for most beneficial uses. They are calcium-magnesium bicarbonate waters with total solids ranging from 64 to 109 ppm and iron from 0.1 and 0.6 ppm. The higher iron concentrations render this water objectionable for domestic purposes. Boron concentrations are low, ranging from 0.01 to 0.19 ppm.

Ground water of Little Lake Valley is generally of good mineral quality for irrigation purposes. It is generally inferior for domestic uses because of iron and manganese content but neverthess is used for that purpose. Mineral analyses of ground water are shown in Table 3, Appendix A. The water is generally a calcium-magnesium bicarbonate type with the exception that sodium concentrations are slightly higher and that total solids are higher, ranging from 70 to 522 ppm. The water contains iron in quantities ranging from 0.2 to 8.3 ppm, and manganese is present in concentrations ranging from 0.2 to 0.71 ppm. Undesirable tastes and objectionable staining characteristics render these concentrations of iron and manganese objectionable in the lower ranges and almost unusable in the higher ranges for domestic use.

A mineral analysis of water from well 18N/13W-18K1 indicates a water relatively high in magnesium and calcium with total solids of 346 ppm and boron concentrations of 1.2 ppm. This water is very hard, containing 271 ppm of hardness expressed as $CaCO_3$. Water from well 18N/14W-12H1 shows a relatively high chloride concentration, total solids of 258 ppm, boron concentration of 3.8 ppm, and iron and manganese concentrations of

8.3 and 0.71 ppm respectively. A mineral analysis of water from well 18N/14W-13N1 shows a relatively high concentration of sodium and bicarbonate, 80 and 564 ppm respectively, total hardness of 326 ppm, 1.3 ppm of iron and total dissolved solids of 522 ppm. While waters from these three wells do not lie in close proximity, differ in quality, and originate from different sources, their composition differs from that of normal ground water of the area; this indicates derivation in part from mineralized waters rising along fault zones or fractures in the underlying rock. Degraded ground waters were not found in other areas of the valley during this investigation.

While no separate and distinct aquifers were found, mineralized water, which apparently originates from deep seated sources, should be prevented from mingling with the normal water supply of the area. When such degraded water is detected during construction of a new well or is found existing in a present well, construction or repairs should be conducted in such a manner that will eliminate the possibility of degradation of the water generally found throughout the area.

Potter Valley

Potter Valley is located in the east central portion of Mendocino County approximately 15 miles northeast of Ukiah. Elevations range from 880 feet at the south end to 1,000 feet at the north end. The valley, a structural basin approximately 7 miles long which averages 1.75 miles wide, contains an alluvial area approximately 12.2 square miles. Location of the valley is shown on Plate 2, areal geology on Plate 4, and location of wells and sampling points on Plate 9.

The valley is served by a paved county road which extends from Cold Creek junction of State Highway 20 through Potter Valley to Van Arsdale Reservoir and Lake Pillsbury.

The town of Potter Valley is a small settlement in the central portion of the valley and is its only community.

Income in the valley is derived primarily from agriculture. Dairy products, beef cattle, and fruit are the major products. Logging in areas adjacent to the valley constitute a minor source of income.

Individual wells furnish the domestic water supply for Potter Valley. Irrigation requirements are satisfied by both ground and surface waters. The valley area is served by the Potter Valley Irrigation District; this system receives water from Potter Valley Powerhouse tailrace and distributes it to the valley area. The remainder of the irrigated lands derives its supply from ground water.

<u>Surface Water Hydrology</u>

A meterological station is located at the Potter Valley Powerhouse. Seventeen years of record beginning in 1939 show an average annual temperature of 58.4° F., and forty-four years of record indicate an average annual precipitation of 41.08 inches (Table 1). Data from 11 meteorological stations located throughout the county indicate that the rainfall in Potter Valley represents an approximate average of the valley areas in the county.

East Fork Russian River enters the valley at the northern end, flows south through the center of the valley, and leaves at the extreme southern end. The entire summer flow of East Fork Russian River is imported from Eel River via Potter Valley Powerhouse of Pacific Gas and

Electric Company for power generation. This flow is relatively constant, depending somewhat on electrical system requirements, and averages approximately 197 cfs. Flow is not interrupted except for maintenance and repairs to the system.

The remainder of the streams in the area, which include Bush, Hawn, White, and Mewhinney Creeks, are tributary to East Fork Russian River and normally do not flow during summer months.

Ground Water Geology and Hydrology

Potter Valley is a structural basin formed during the folding and faulting of the Coast Range.

Lithologic units can be grouped into three categories. Deposits of major importance as a source of ground water include Recent alluvium and river channel and terrace deposits. Semi-consolidated clay, sand, and gravel deposits of late Tertiary or early Pleistocene age, although extensive, do not constitute an important source of ground water. Deposits of minor importance as a source of ground water include sedimentary and metamorphic rock units of the Franciscan group of Jurassic age which underlie the entire area. Ground water is produced in small quantities around the edges of the valley from joints and fractures in this formation.

Recent Alluvium, River Channel Deposits, and Terrace Deposits. Recent alluvium and river channel deposits consist of loose, unconsolidated gravel, sand, silt, and clay. Alluvium ranges in thickness from a very thin veneer of only a few inches to sections over 60 feet thick. The following composite log indicates the type of material commonly found in Potter Valley:

Depth in feet	Material	Depth in feet	Material
0 - 3	Top soil and hardpan	35 - 50	Blue clay and gravel
3 - 10	Yellow clay and sand	50 - 55	Gravel
10 - 20	Gravel	55 - 90	Blue clay
20 - 35	Blue clay	90 - 100	Cemented gravel
		100 - 125	Blue clay

As shown on Plate 4, alluvial deposits cover almost the entire northern half of the valley and extensive low land areas in the southern portion. Gravels and sand which form the water-bearing zones are, in general, quite permeable, but they do not extend to all parts of the valley. In certain areas alluvium is composed almost entirely of silt and clay; permeability is very low.

Terrace deposits of Recent and Pleistocene age are made up of clay, silt, sand, and gravel laid down as continental flood plain and fan deposits and lacustrine sediments. Thickness of terrace deposits ranges from a few inches to over 100 feet. Permeability is low due to abundance of clay and silt in the formation. Terrace deposits outcrop in the south and east portions of the valley where erosion has reduced exposures to discontinuous areas.

A continuous aquifer of limited vertical and horizontal extent covers the northern half of Potter Valley. This aquifer covers approximately the south half of Section 6, all of Sections 7 and 18, the west half of Section 17, and northwest quarter of Section 20, all of these locations lying in Township 17 North, Range 11 West. This aquifer averages 30 feet in thickness and extends from depths of approximately 20 feet. It is composed of gravels interspersed between clay lenses. In an irregular area in Township 17 North Range 11 West, which covers a south fraction of Section 7, the east half of Section 18, the west half of Section 17, and the northwest quarter of Section 20, as indicated on Plate 9, a clay cap exists, and water in the aquifer is confined. Movement of ground water in this aquifer is impeded by lenticularity and abundance of clay and silt. Specific capacities are low to moderate, ranging from 0.5 to 25 gpm per foot of drawdown.

Ground water movement is greatly impeded by an abundance of clay and silt and by lack of sand and gravel east of Russian River. Yields although small, are normally sufficient for limited use.

Alluvium in the southern portion of the valley is composed of a larger percentage of clay and silt than that found in the northern half. Movement of ground water is greatly impeded by the clay and silt, by lenticularity of more permeable zones, and by discontinuities due to topography and erosion. Ground water occurs in isolated lenses of permeable material and occurs to a limited extent in less permeable material.

Ground water levels vary from depths of 20 feet in the fringes of the valley to artesian flows above land surface in the pressure area in the center of the valley.

Perched water overlying the pressure zone and resulting from direct precipitation and irrigation return water poses a drainage problem which has been partially solved by a series of drains discharging to East Fork Russian River.

Major sources of recharge to ground water include percolation of precipitation, excess irrigation water, losses from unlined irrigation canals, and percolation from surface streams.

Tertiary-Quaternary Sediments. Tertiary-Quaternary sediments are composed of interbedded clay, silt, sand, and gravel laid down as continental flood plain and lake sediments. Age of these beds is thought to be late Pliocene or early Pleistocene. Outcrops of this formation are limited to the south half of the valley. This formation is well exposed in the low hills west of the county road along the west side of the valley and in a small segment south of Mewhinney Creek. Deformation and erosion have reduced exposures of this formation to the present discontinuous remnants.

Permeability of these sediments has been decreased by consolidation and cementation. A few shallow wells produce from this formation, but yields are low.

Water Quality

Surface water in Potter Valley is normally of excellent mineral quality and is suitable for most present beneficial uses. Available mineral analyses are contained in Table 2, Appendix A, and locations of sampling points are shown on Plate 9. These waters are characteristically calcium-magnesium bicarbonate or calcium bicarbonate. The major portion of flow in East Fork Russian River is water imported from Eel River via Potter Valley Powerhouse. This water is a calcium-bicarbonate type with total solids ranging from 78 to 88 ppm. Boron concentrations in East Fork Russian River are low ranging from 0.06 to 0.19 ppm. Tributaries to East Fork Russian River within the valley normally contain a calcium-magnesium bicarbonate water with total solids ranging from 129 to 227 ppm. Boron concentrations in the tributaries range from 0.02 to 0.67 ppm. These boron concentrations are not sufficient to cause damage to any but the most sensitive plants.

Ground water in this area is normally of excellent mineral quality, except for appreciable iron concentrations in some wells which render the water objectionable for domestic uses without treatment. Mineral analyses of ground water are contained in Table 3, Appendix A. Ground water is characteristically a calcium-magnesium bicarbonate or a magnesium-calcium bicarbonate water with total solids ranging from 140 to 395 ppm. Iron concentrations range from 0.0 to 1.2 ppm. Boron is present in concentrations ranging from 0.04 to 0.61 ppm.

A mineral analysis of water from well 17N/11W-33D1 which extends 678 feet deep, mainly penetrating the Franciscan formation, showed a sodium-magnesium bicarbonate water with total solids of 1,020 ppm and a boron concentration of 1.0 ppm. This well produces a maximum of 5 gpm. This water is indicative of deep seated water or entrapped water derived from the Franciscan formation. Normal ground water exhibits little similarity with this water, an indication that this source provides negligible recharge to the main ground water body.

Drainage and irrigation return water above the clay cap existing over the pressure aquifer should be prevented from entering the aquifer since such water is normally more highly concentrated than naturally occurring waters. Wells encountering highly mineralized waters from the Franciscan formation should be constructed so that these mineralized waters will not endanger the normal ground water.

Round Valley

Round Valley is located in the northern section of Mendocino County approximately 30 miles north of Willits. The valley is an oval structural basin approximately 6 miles long and 4 miles wide containing an alluvial area of approximately 22.6 square miles. Elevation of the valley floor ranges from 1,300 feet at the south end to 1,440 feet at the north end. Location of the valley is indicated on Plate 2, geology on Plate 4, and location of wells and sampling points on Plate 9.

Covelo, the only town in the valley, is centrally located and is served by county roads from Dos Rios and Williams.

Income in Round Valley is derived from agriculture and lumber. Sheep, cattle, hay and cereals are the principal agricultural products. Much of the valley land is devoted to pasture.

Ground water satisfies all requirements for domestic use and supplies a major portion of irrigation and industrial needs because of lack of a firm supply of surface water in the valley.

Surface Water Hydrology

The United States Weather Bureau meteorological station at Covelo reports an average annual temperature of 56.1°F. for a 16-year period and an average annual precipitation of 38.22 inches for a 37-year period (Table 1).

There are no major streams in Round Valley. Several small creeks including Short, Mill, Town, Grist, and Turner drain across the valley in a general southerly direction. Near the south end of the valley tributary creeks converge to form Mill Creek which enters Middle Fork Eel River approximately three miles southeast of the valley.

Streams within the valley normally do not sustain perennial flow and become dry by late summer or early fall.

Ground Water Geology and Hydrology

Round Valley is a broad structural basin surrounded by high, grassy, wooded hills. It has been postulated that the depression was formed by faulting.

In relation to occurrence of ground water, lithologic units can be grouped into three categories. Deposits of major importance as a source of ground water include Recent alluvium and river channel deposits. Deposits of secondary importance include semi-consolidated clay, sand, and gravel of late Tertiary or early Pleistocene age. Deposits of minor importance as a source of ground water are sedimentary and metamorphic rock units of the Franciscan group of Jurassic age which underlie the entire area. Springs producing limited water from this formation have been developed in a few locations around the margins of the valley.

Recent Alluvium and River Channel Deposits. River channel deposits occur as thin veneers of gravel and sand along the streams for some distance after they enter the valley and along Mill Creek for a distance of some three miles before the creek leaves the valley. The deposits range in thickness from a few inches to perhaps 20 feet and are very permeable, but due to their limited extent they constitute a negligible source of ground water. They serve as a permeable intake area for recharge of ground water in the valley.

Recent alluvium consists of loose, unconsolidated gravel, sand, silt, clay, and loamy soil. As shown on Plate 4, alluvium and river channel deposits occupy the entire floor of Round Valley. Recent alluvial fans were recognized at the mouths of several of the smaller canyons, but they were of such limited areal extent that they could not be shown on a map at the scale used in this report. Alluvium ranges in thickness from a few inches near the margins to an estimated average maximum depth of over 500 feet near the south central part of the valley. A composite log of the upper sediments follows:

Depth in feet	Material	Depth in feet	Material
0 - 10	Top soil	80 - 90	Gravel and sand
10 - 30	Yellow clay	90 - 130	Clay and gravel
30 - 35	Gravel	130 - 140	Yellow clay and gravel
35 - 80	Blue sandy clay		

Interbedded and intermixed gravel, sand, silt, yellow clay, and blue clay are encountered in irregular sequences similar to the above composite log in most wells in the valley, including those wells penetrating over 700 feet.

A semi-continuous aquifer exists generally throughout the valley. However, ground water movement is impeded by a fault barrier which extends into the alluvial material. Shallow wells yield sufficient quantities of ground water for domestic and limited irrigation uses. Deeper wells, those over 300 feet, normally yield from 300 to 1,000 gpm with drawdowns of 60 to 100 feet. Specific capacities thus range from 5 to 13 gpm per foot of drawdown with a few as high as 50 gpm per foot. As shown on Plate 9, a pressure area exists generally east of Commercial Avenue and north of Fairbanks Road and covers the northeast section of the valley.

In the south end of the valley depths to water range from 20 to 40 feet. In this area ground water is used extensively for irrigation. This represents the largest draft on ground water in the valley. In the fringes of the pressure area water levels vary from ground surface or above during the spring to depths of 10 feet below ground surface during late summer. In the center of the pressure area water levels remain at or above ground surface throughout the year. In the pressure forebay area water levels fluctuate between 10 and 40 feet below the surface.

Ground water moves in a general south and southeast direction throughout the valley. The pressure area is recharged from the west side of the valley and from headwaters of several small creeks draining hills east of the valley. Throughout the west and south portions of the valley recharge is provided by direct percolation of precipitation, stream flow, and irrigation return water.

Consolidated rocks rimming the valley prevent ground water outflow from the basin, and the stream channel of Mill Creek which cuts across the consolidated rock at the southeast end provides the only means of exit. All outflow from the valley is forced to rise to the stream bed and leave as surface water.

Tertiary-Quaternary Sediments. This formation is composed of interbedded clay, silt, sand, and gravel laid down as continental flood plain and fan deposits with interbedded lacustrine sediments. Age of these beds is thought to be Pliocene or early Pleistocene. This formation outcrops in the low hills at the extreme south and southeast margin of the valley, where the formation appears to be over 200 feet thick. The beds dip gently to the north and northeast and probably extend across the valley under the alluvium. Where exposed, the formation has been deeply dissected by erosion.

Permeability of Tertiary-Quaternary sediments has been decreased by consolidation and cementation. A few wells were found to be producing from this formation. It is probably penetrated by most of the deep wells in the southern part of the valley.

Water Quality

Surface water throughout Round Valley is of excellent mineral quality, suitable for all present beneficial uses. The surface waters without exception are calcium-magnesium bicarbonate in character. Total solids are low, ranging from 80 to 171 ppm as shown in Table 2, Appendix A. Boron is present in negligible quantities, ranging from 0.01 to 0.18 ppm.

At all known depths ground water throughout the valley is of excellent mineral quality for irrigation purposes, but high iron concentrations of from 1.6 to 7.4 ppm render these waters objectionable for domestic use without treatment for removal of iron. With two exceptions these are normally calcium-magnesium bicarbonate waters with total solids ranging from 116 to 269 ppm. Boron concentrations are low, ranging from 0.00 to 0.24 ppm. Mineral analyses of ground water are presented in Table 3, Appendix A.

One well, 22N/12W-21A1, showed a sodium bicarbonate water with total solids of 392 ppm, and another well, 23N/12W-26E1, located in Poor Mans Valley 2.5 miles northeast of Covelo, showed a chloride concentration of 25 ppm, well above the average of 4.0 ppm for normal ground water in Round Valley.

Water well construction in Round Valley should reflect the conditions found in the pressure area to avoid unnecessary loss of pressure head and to prevent downward migration of irrigation return and other mineralized waters.

Ukiah Valley

Ukiah Valley, the largest and most important alluvial area in Mendocino County, is located in the southeast section of the county approximately 110 miles north of San Francisco and 30 miles east of the Pacific Ocean. The valley location is indicated on Plate 2, areal geology is shown on Plate 3, and wells and sampling points are located on Plate 8. The valley is approximately 22 miles long and attains a maximum width of five miles; it encompasses an alluvial area of 64.9 square miles. Elevation of the valley floor ranges from 530 feet at the south end to 850 feet at the north end.

The economy of Ukiah Valley is more diversified than that of the remainder of the county. Income is derived from timber processing, industrial services and supplies, agriculture, and small manufacturing. A large wood processing plant located near Ukiah has served to stabilize employment in the area. Major agricultural products include sheep, cattle, cereals, hops, and grapes. A state mental institution located at Talmage furnishes employment for a number of persons on a year round basis and further serves to stabilize the economy.

Three communities, Ukiah, Talmage, and Calpella, are located in the valley. Ukiah, situated in the central portion of the valley, is the largest city in Mendocino County and is the County seat. A 1950 population of 6,120 was reported for Ukiah. Calpella, in the northern end of the valley, and Talmage, in the central portion of the valley, are small unincorporated communities. In 1950 Ukiah Valley supported a total population of 16,130.

The area is traversed by U. S. Highway 101 and Northwestern Pacific Railroad. Access is also furnished by State Highway 20 from Lake County, by Low Gap and Orrs Springs Roads from the coast, and by numerous county roads within the valley. Ukiah has airline connections to the north and south.

Domestic water supplies are derived entirely from ground water. However a number of shallow domestic wells and the municipal supply for the city of Ukiah are located in gravels adjacent to Russian River and undoubtedly derive a portion of their supply from underflow.

Irrigation requirements are met by ground water and surface water from Russian River. In general most of the land adjacent to Russian River is irrigated directly by water from the river or by water supplied by shallow wells deriving their supply from underflow. Lands not contiguous to the river are in general irrigated from ground water. Industrial supplies are obtained primarily from ground water.

Surface Water Hydrology

There are two meteorological stations located in Ukiah Valley. One is located at Ukiah, the other in Redwood Valley two miles north of Calpella. At Ukiah the average annual temperature for a 63-year period is 57.8° F. and the average annual precipitation for an 84-year period is 35.35 inches. At Redwood Valley average annual precipitation for an 18-year period is 36.07 inches (Table 1).

The entire valley is drained by Russian River and tributaries. East Fork Russian River drains Potter Valley and receives approximately 197 cfs importation from Eel River through the Potter Valley Powerhouse. This branch enters at the northern end of Ukiah Valley and merges with Russian River at The Forks approximately three miles north of Ukiah. Above The Forks the main branch of Russian River drains Redwood Valley. This branch of Russian River is dry during the summer months. Flow in East Fork Russian River is perennial. It is greatly affected by diversion from Eel River through Potter Valley Powerhouse. Below The Forks flow in the Russian River is perennial in all reaches. Streams in Ukiah Valley tributary to Russian River normally contain appreciable flow only during winter and spring months. Tributaries include Forsythe, York, Eldridge, Hensley, Ackerman, Orrs, Sulphur, Middle, Austin, Robertson, Morrison, and McNab Creeks. These streams drain the hills rimming the valley and are developed in an east-west direction, whereas the course of Russian River is to the south.

Ground Water Geology and Hydrology

Ukiah Valley, the largest ground water basin in Mendocino County, is a patch work of dissected hills, numerous terraces, low, broad alluvial fans, and wide flood plains. The valley is surrounded by rugged, grassy, wooded ridges.

Lithologic units can be grouped into three categories. Deposits of major importance as a source of ground water include Recent alluvium, river channel deposits, and terrace deposits. Deposits of secondary importance include semi-consolidated sediments of Tertiary-Quaternary age. Of minor importance are sedimentary and metamorphic rock units of the

Franciscan formation of Jurassic age which yield water, sometimes highly mineralized, to several springs in the area.

Recent Alluvium, River Channel Deposits, and Terrace Deposits. Recent alluvium consists of loose, unconsolidated gravel, sand, silt, and clay. As shown on Plate 3, alluvium occupies the central portion of the valley, the most extensive area of alluvium occurring in the vicinity of Ukiah. Alluvium varies in thickness from a few inches to over 100 feet. Alluvium is underlain in part by terrace deposits, in part by Tertiary-Quaternary formation, and in part by Franciscan bedrock. A composite well log indicating the types of sediments which comprise the alluvium follows:

Depth in feet	Material	Depth in feet	Material
0 - 2	Top soil	45 - 55	Yellow clay and gravel
2 - 10	Yellow silt, and yellow clay with embedded gravel	55 - 60	Loose gravel
		60 - 65	Yellow clay and gravel
10 - 20	Sandy clay	65 - 70	Blue clay
20 - 25	Loose gravel	70 - 80	Yellow clay
25 - 45	Blue clay	80 - 85	Cemented gravel

A small area of older alluvium consisting of travertine from nearby mineral springs as well as gravel, sand, silt, and clay covers the floor of Sulphur Creek along Vichy Springs Road.

Stream channel deposits are composed of a thin veneer of gravel, sand, and silt along the entire length of Russian River and East Fork Russian River within the valley. These deposits range in thickness from a few inches to perhaps 40 feet and are very permeable.

Several distinct terraces were observed in the Ukiah Valley area. For convenience in mapping, these were combined into two groups based upon relative age and position. Younger terraces are of Recent and possibly late Pleistocene age. These terraces occupy extensive areas adjacent to the alluvium along the entire west side of the valley south of The Forks, and they are well developed near Talmage, Calpella, and in Coyote Valley. Older terraces thought to be Pleistocene in age occupy positions topographically higher than the younger terraces. The older terraces blanket most of Redwood Valley. Eroded remnants of older terraces are prominent on both sides of the valley as far south as The Forks; only a few scattered remnants were found in the south end of the valley.

Terrace deposits are made up of bouldery clay, yellow and brown clay and silt, sandy clay, sand, and gravel which were laid down as continental flood plain and fan deposits. These are interbedded with blue and green clays which probably were deposited as lake sediments. Thickness of terrace deposits varies from a few feet to over 200 feet. Yield of ground water to most wells is low because of an abundance of clay and silt in the formation.

Terrace deposits underlie alluvium throughout much of Ukiah Valley and unconformably overlie Tertiary-Quaternary sediments. Exposures of these deposits are very extensive and have been made discontinuous by erosion. A composite log indicating typical material in the terrace deposits follows:

Depth in feet	Terrace deposits	Depth in feet	Terrace deposits
0 - 2	Surface soil	50 - 60	Tough yellow clay
2 - 10	Hardpan	60 - 65	Tough sticky blue clay
10 - 15	Yellow clay with embedded gravel	65 - 70	Yellow clay with embedded gravel
15 - 25	Hard sandstone	70 - 75	Soft sandstone
25 - 35	Clay with embedded gravel	75 - 80	Sandy blue clay
35 - 40	Sandy yellow clay	80 - 95	Gravel embedded in yellow clay
40 - 50	Clay and gravel	95 - 125	Sandy blue clay

Recent alluvium, which covers most of the valley floor, varies in permeability from low to moderate. These deposits supply most of the ground water requirements of Ukiah Valley. Yields range from 50 to 1,000 gpm with drawdowns from 10 to 100 feet. Specific capacities usually vary between 0.5 and 7 gpm per foot of drawdown, but locally they may exceed 100 gpm per foot.

Stream channel deposits along the major streams are extremely permeable, but they are limited in areal extent and attain a maxiumum thickness of only 40 feet. However, these channel deposits support underflow of considerable magnitude, and yields to shallow wells from this source are considerable.

Terrace deposits, particularly prevalent in Redwood Valley north of Calpella, furnish low yields to wells because of abundant clay and silt in the formation and because of lenticularity of permeable materials. Some permeable lenses in the terrace deposits yield no appreciable ground water due to lack of connection with possible sources of recharge. Many wells drilled in Redwood Valley have been abandoned because of failure to find sufficient water to warrant their development. Yields range from negligible quantities to 15 gpm for drawdowns of 10 to 100 feet. Where requirements are low and use is intermittent, dug wells furnish the firmest supply from these deposits because they contain a relatively large storage volume within the well shaft.

Water levels vary between artesian conditions and depths of 40 feet. Adjacent to the river gravels depths to water vary between zero and 10 feet and appear to fluctuate directly with water levels in the river. In the remainder of the valley little correlation appears between water levels. Lenticularity of the sediments causes minor pressure effects throughout the valley.

Three sources contribute to recharge of ground water; percolation of stream flow, percolation of precipitation and irrigation return water, and migration of water stored in joints and fractures of the normally consolidated rocks surrounding the valley.

Recharge of gravels adjacent to Russian River occurs directly from the river. However, this recharge primarily is limited to those units mapped as river channel deposits, as shown on Plate 3. Water levels in these gravels are controlled primarily by the river. Water levels in the less permeable material adjacent to the river gravels are normally higher than levels in the river causing water to flow toward the gravels. Recent alluvium, terrace deposits, and Plio-Pleistocene sediments receive recharge mainly from direct percolation of stream flow and of precipitation.

Tertiary-Quaternary Sediments. These sediments are composed of interbedded gravelly clay and silt, blue clay, sand, and gravel laid down as flood plain, fan, and lake deposits. Outcrop areas of this formation are the most extensive of any unit in the water-bearing series. This formation outcrops in hills along almost all of the east margin of Ukiah Valley, in hills surrounding Coyote Valley, and in hills east and west of Calpella. The formation is thought to be approximately 1,000 feet in thickness. A composite log indicating lithology typical of Tertiary-Quaternary sediments follows:

Depth in feet	Tertiary-Quaternary sediments	Depth in feet	Tertiary-Quaternary sediments
0 - 3	Sandy clay	50 - 55	Blue clayey sandy gravel
3 - 15	Gravelly loam	55 - 90	Blue sandy clayey gravel
15 - 20	Blue sandstone	90 - 100	Blue clayey sandy gravel
20 - 25	Blue sandy clay	100 - 105	Olive drab sandy clay
25 - 30	Sandy conglomerate	105 - 150	Blue clayey gravel and sandy clay
30 - 50	Blue clayey gravel		

Deformation and erosion have reduced the formation to discontinuous remnants. Evidence of deformation is found in varying gentle strikes and steep dips recorded in various outcrop areas.

Permeability of the Tertiary-Quaternary sediments has been decreased by consolidation and cementation. Yield to wells is very low. Gravels which would appear to be potential aquifers have been penetrated by many wells in search of water, but the gravels yielded only a negligible quantity of ground water because of the abundance of clay and silt in the gravel and because of isolation of the gravel beds from sources of ground water supply by intervening clay and silt.

Water Quality

Surface water in Ukiah Valley is generally of excellent mineral quality and is suitable for most present beneficial uses. Mineral analyses of surface water are shown in Table 2, Appendix A. Water in East Fork Russian River, the only water in the valley not originating locally, is of excellent mineral quality. This supply consists of water imported from Eel River and of water originating in Potter Valley and Cold Creek areas.

Russian River water is calcium bicarbonate in character with total solids of 84 to 136 ppm. Boron concentrations are usually low. However, during periods of low flow, the effect of the tributaries containing appreciable quantities of boron becomes pronounced, and boron concentrations as high as 1.06 ppm have been recorded at the south end of the valley. Water in Russian River above the confluence with East Fork Russian River is a calcium bicarbonate type with low total solids and low boron concentrations.

Tributaries to Russian River within Ukiah Valley normally contain water similar in quality to that found in the river. However, two tributaries, Sulphur Creek and Middle Creek, both of which drain an area east of Russian River and slightly south of Ukiah, show relatively high concentrations of boron. Sulphur Creek derives a portion of its supply from the highly mineralized waters of Vichy Springs. These springs lie in the Franciscan formation. This water is a sodium bicarbonate type with total solids of 639 ppm, per cent sodium of 75, boron concentration of 13 ppm, and chloride concentration of 53 ppm. Middle Creek, whose water is not as highly mineralized as that of Sulphur Creek, contains a calcium bicarbonate water with total solids of 285 ppm and boron concentration of 1.6 ppm. Composition of these waters suggest derivation, in part, from deep seated, juvenile, or entrapped mineralized waters in the Franciscan formation.

Ground water in Ukiah Valley is of extremely variable character. Mineral analyses of ground water are contained in Table 3, Appendix A. Shallow ground water along the river is a calcium-magnesium bicarbonate type, very similar to normal surface waters of the area. Total solids range between 138 and 259 ppm, and boron concentrations are low, from 0.00 to 0.24 ppm. This water is of excellent quality and is suitable for all present beneficial uses. Several wells in the valley contain relatively mineralized waters. One of these, 15N/12W-22D1, 22 feet deep, contains a sodium-calcium bicarbonate water with an electrical conductance of 550 micromhos and a boron concentration of 6.05 ppm, suggesting derivation in part from deep seated or juvenile waters probably rising along fault zones. Locations of this well and other sampling points are indicated on Plate 8.

Wells along the edge of the valley frequently contain highly mineralized water. Well 15N/12W-14C1, located in the east central portion of the valley, produces a sodium bicarbonate water with a boron concentration of 8.40 ppm. This well is located near Sulphur Creek only a short distance downstream from Vichy Springs. A University of California analysis of water from a 300-foot domestic well in the southwest portion of the valley, 14N/12W-26K1, showed a sodium concentration of 170 ppm, a chloride concentration of 300 ppm, and a boron concentration of 39.2 ppm. Another analysis on the same date showed similar results. Well 17N/12W-18A1, a 57-foot domestic well located in the northern end of Redwood Valley, contained a sodium chloride water with sodium concentration of 292 ppm and chloride concentration of 466 ppm. Total solids were 1,030 ppm, boron concentration was 55 ppm, and iron content was 11 ppm.

Many highly mineralized springs which derive their supply from deep seated or juvenile water and which contribute to degradation of usable ground water (28) exist along the edges of the valley.

Even though no highly permeable continuous aquifers exist in Ukiah Valley, the presence of a number of wells containing mineralized waters indicates the need for well construction practices designed to eliminate the commingling of such poor quality water with the normally excellent quality water. It is highly possible that faults have affected the underlying Tertiary-Quaternary deposits and provide means of upward migration of highly mineralized water contained in the Franciscan formation. When wells yield poor quality water, they should be constructed in such manner that will eliminate the opportunity for commingling of such water with usable water.

Fort Bragg Coastal Terrace and Contiguous Areas

The Fort Bragg Coastal area is located in the extreme western portion of the county. It is bordered on the west by the Pacific Ocean, on the north by Cape Vizcaino, and on the south by Navarro River. It extends inland from the coast a maximum of 10 miles. Location is shown on

Plate 2, areal geology on Plate 5, and locations of wells and sampling points on Plate 10. The area is oriented in a north-south direction and contains approximately 41.6 square miles of alluvial land. It is composed of numerous dissected marine terraces separated by alluvium deposited in river channels. Many of the small, separate alluvial valleys in this unit have been separately named and numbered. However, for ease of presentation these are grouped and discussed in this section as the "Fort Bragg Coastal Terrace and Contiguous Areas".

Income in the Fort Bragg area is derived principally from logging and lumber processing, although sport and commercial fishing, poultry, and dairying are important to the economy of the area.

Fort Bragg is the major town in the area. Communities of lesser importance include Westport, Inglenook, Noyo, Caspar, Mendocino, Little River and Albion.

State Highway 1 follows the coast line throughout the entire area. The area also is served by roads from Laytonville, Willits, and Anderson Valley and by the California Western Railroad and Navigation Company from Willits to Fort Bragg.

Domestic water supplies are obtained primarily from ground water, although a few small diversions of surface waters from minor streams exist in the area. Municipal supplies for Fort Bragg and for several of the smaller communities are derived from surface water. Irrigation requirements, limited to pasture or small truck farms, are minor and are usually met by ground water. Industrial requirements are minor and are limited to lumber and fish processing plants. Since these industries generally are located adjacent to streams along the coastal margin, their requirements are usually met by surface water.

Surface Water Hydrology

A meteorological station is located in Fort Bragg. Sixty-three years of record since 1893 indicate an average annual temperature of 52.9° F. Precipitation during the same period has averaged 37.48 inches. Precipitation probably is considerably higher only a few miles inland.

Numerous small creeks and rivers drain the area west of the interior and flow directly into the Pacific Ocean. Major streams in the area are Big, Noyo, and Ten Mile Rivers which combine with the smaller streams to drain all of the area west of Little Lake, Ukiah, and Sanel Valleys. A stream gaging station located near the mouth of Noyo River shows an average discharge of 323 cfs for three years of record.

All of the major streams in the area sustain perennial flow, but many of the smaller creeks become dry or nearly dry during late summer and early fall.

Ground Water Geology and Hydrology

The area designated as Fort Bragg Coastal Terrace and Contiguous Areas is bounded on the west by steep vertical cliffs that drop almost 50 feet to the Pacific Ocean and on the east by the rugged peaks of the northern Coast Range that rises to a maximum altitude of 2,000 feet within 5 miles of the coast.

During the Pleistocene epoch the entire coast line was uplifted. Presence of marine terraces at several different elevation levels indicates more than one period of uplift. The terraces rest uncomformably on underlying bedrock and have been severely dissected by streams. For simplicity the marine terraces are mapped into two groups. Group 1 includes all terraces between 50 and 250 feet in elevation and Group 2 includes all terraces between 250 and 500 feet (Plate 5). Several terrace remnants exist over 500 feet in elevation, but they have not been mapped because of their small size and isolated locations.

A fairly large sand dune area forms the only major break in the line of cliffs along the coast. The dunes, located a few miles north of Fort Bragg, cover an area three to four miles in length and approximately one mile in width. These dunes are about 50 feet thick and are over 100 feet in elevation at their eastern edge.

Lithologic units can be grouped into two categories. Deposits of major importance as a source of ground water include semi-consolidated Pleistocene marine terraces, unconsolidated Recent alluvium and river channel deposits, and the sand dune area north of Fort Bragg. Deposits of minor importance as a source of ground water include sedimentary and metamorphic rock units of the Franciscan group of Jurassic age. However, limited water supplies have been developed from wells and springs supplied from joints and fractures in this formation.

The Pleistocene marine terrace deposits are composed of clay, silt, sand, and gravel that was deposited in littoral and offshore zones of the seacoast during Pleistocene time. Subsequent uplift elevated the terraces, and the westward flowing rivers and creeks dissected the uplifted deposits.

A characteristic section of the terrace deposits is exposed on the cliffs facing the ocean several miles north of Fort Bragg. The orange-brown colored terrace deposits rest unconformably on greenish-black Franciscan rock and extend from 12 to 15 feet in thickness. The bottom four feet of the section primarily consist of well rounded grey pebbles 3/4 to 1 inch in diameter. Fine sand and silt fill the interstices between the pebbles and predominate throughout the rest of the section. The sediments are derived from mountains to the east from disintegration and erosion of underlying Franciscan bedrock.

Thickness of the terrace deposits ranges from a few inches to over 50 feet. Evidence gathered from drillers' logs of water wells in the coastal area indicates that the widest and most extensive terraces, which occur in the vicinity of the town of Fort Bragg, have appreciably thinner deposits than the narrow terraces near the town of Mendocino. Two composite logs indicating the types of materials commonly encountered are shown as follows:

Depth in feet	Marine terrace deposits near Fort Bragg	Depth in feet	Marine terrace deposits near Albion
0 - 20	Soft soil and gravel	0 - 60	Fine sand
20 - 35	Gravel	60 - 65	Hard brown rock (Franciscan formation)
35 - 40	Hard brown rock (Franciscan formation)		

Recent alluvium composed of silt, sand, and gravel is deposited on flanks of coastal creeks and rivers. The most extensive deposits are found in the valleys of Ten Mile, Noyo, Big, Albion, and Navarro Rivers. Alluvial areas average 0.25 mile in width and extend inland for a maximum distance of 10 miles (Plate 5). Streams erode sediments from mountainous areas to the east and deposit them in flood plains and stream channels near the coast where their gradients decrease. Maximum thickness of these deposits in the Fort Bragg coastal area is unknown since no wells have been drilled in river channel deposits because of availability of surface water.

The sand dunes, located approximately three miles north of Fort Bragg, constitute a source of ground water of minor importance. In the sand dune area the coast lies approximately normal to the prevailing winds from the northwest. The winds blow the sand grains from the beach to the southeast. Fine, well-sorted sands are deposited on the leeward slopes of dunes near State Highway 1. The dunes are very permeable and constitute no hydrologic barrier to prevent the outflow of ground water to the ocean.

There are no continuous or extensive ground water aquifers in the Fort Bragg coastal area. Ground water is stored in marine terrace deposits of clay, silt, sand, and gravel that overlie much of the area; in the silt, sand, and gravel of river channel deposits found adjacent to most of the streams; and to a minor extent in fractures and joints of underlying consolidated bedrock and in the sand dune area.

Yields to wells in the terraces vary from 1 to 30 gpm. Yields are low because of thinness, cementation, and dissection of terrace deposits and because of lack of ground water. This lack of ground water is attributed to the appreciable slope of the contact between the underlying bedrock and the terrace material and to the absence of hydrologic barriers to prevent escape of ground water. Depths to water vary from two to eight feet in most of the terraces. The lack of continuity of ground water throughout the terraces is illustrated by the abandonment of numerous wells because of lack of water. Yields vary greatly within individual terraces and between adjacent wells.

Water Quality

Without exception surface water in this area is of excellent mineral quality, suitable for all present beneficial uses. Mineral analyses of surface water are contained in Table 2, Appendix A. This water is characteristically a calcium-sodium bicarbonate water, although magnesium concentrations approach those of sodium or calcium in many of the analyses. Total solids range from 60 to 171 ppm. Boron concentrations range from 0.00 to 0.66 ppm. An analysis of water from Salmon River displayed a marked presence of sodium chloride. Since the sample was obtained near the mouth, it is assumed that sea water penetrated this distance and affected the sample.

Ground water in this area is normally of excellent mineral quality, although a few samples show evidence of derivation in part from mineralized waters rising along fault zones or fractures in underlying rock formations and in part from intrusion of sea water. Mineral analyses of ground water are shown in Table 3, Appendix A. Normal ground waters of the area are sodium chloride-bicarbonate with total solids ranging from 88 to 414 ppm. Sulphate and nitrate concentrations are negligible. Boron is present in minor amounts.

Spring 17N/16W-28F1 shows a sodium bicarbonate water containing total solids of 6,110 ppm, boron of 205 ppm, and potassium of 44 ppm. Another spring, 17N/16W-35R1, shows a calcium-sodium bicarbonate water with 1,730 ppm total solids and boron concentration of 23 ppm. Waters from these springs undoubtedly are derived largely from juvenile, deep seated, or other mineralized waters rising along joints or fractures in the Franciscan formation.

A 12 foot auger test hole in MacKerricher State Park, 19N/17W-19R1, showed a sodium-calcium bicarbonate water with total solids of 891 ppm and boron concentration of 35 ppm. An adjacent well, 19N/17W-19R2, 70 feet deep, had a sodium chloride water with total solids of 209 ppm and boron concentration of 0.06 ppm. Water from the auger test hole shows evidence (particularly the high boron concentration) of derivation from a deep seated water rising along a fault zone extending into the terrace material. Water from the adjacent deeper well indicates slight intrusion of sea water. The base of the well lies below sea level and extends approximately 20 feet into bedrock which is probably fractured. This may allow entrance of sea water.

Well 21N/17W-29N1 produces water containing relatively high concentrations of sodium and chloride and total solids of 225 ppm, and boron of 0.23 ppm; this indicates either the presence of entrapped water at the base of the terrace on which the well is drilled or the upward migration of poor quality water from Franciscan bedrock.

Several additional ground waters, as shown in Table 14, show derivation in some degree from mineralized waters rising along fractures or joints in the underlying rocks. Numerous isolated areas appear to be affected in varying degrees.

Since most of the ground water occurs in isolated and separated areas, degradation of one small area probably will not appreciably affect the water supply of the entire area. However, well construction practices should be sufficient to prevent such degradation occurring as a result of movement of poor quality water into better quality water through water wells.

Point Arena Coastal Terrace and Contiguous Areas

The Point Arena area is located in the southwestern portion of the county. This area extends from the Sonoma County line on the south to and including Navarro River on the north and extends from the Pacific Ocean on the west inland to a maximum of five miles. The location is shown on Plate 2, areal geology on Plate 6, and locations of wells and sampling points on Plate 11. The area, including minor areas separately named and numbered, is oriented in a north-south direction and contains approximately 30.1 square miles of alluvial land (Table 5). However, for ease of presentation these minor areas are discussed as a group in this section.

Income in the Point Arena area is derived from lumber, fishing, and agriculture. Agricultural enterprises include dairying, cattle, sheep, hogs, and hay.

The major town in the area is Point Arena. Other communities include Elk, Manchester, and Gualala.

State Highway 1 extends north and south through the area. County roads connect the area with Anderson Valley.

Ground water generally satisfies domestic requirements, although a few stream diversions were found in the area. Irrigation requirements are minor and are satisfied by both surface and ground water.

Surface Water Hydrology

As shown in Table 1, precipitation at Point Arena has averaged 35.13 inches for six years beginning in 1950.

Numerous streams drain the area lying west of the interior valleys. These streams include Greenwood, Mate, Brush, Elk, and Alder Creeks and Navarro, Garcia, and Gualala Rivers. The majority of these streams sustain perennial flow. Discharge records are available only for Navarro River; these show an average discharge of 657 cfs for the four years of record extending from 1950 to 1953.

Ground Water Geology and Hydrology

The Point Arena Coastal Terrace and Contiguous Areas west of the San Andreas fault zone are underlain by consolidated marine sediments and volcanics ranging from Cretaceous to Tertiary in age. East of the San Andreas fault zone rock types are sedimentary, igneous, and metamorphic and belong to the Franciscan group of Jurassic age. Unconsolidated and dissected marine terrace deposits lie unconformably on the bedrock. An area of sand dunes is located along the coast between the mouths of Garcia River and Alder Creek. The dunes vary from 0.1 to 0.75 mile in width and reach a maximum elevation of approximately 50 feet. From the mouth of Garcia River southward to Gualala River, the coast is characterized by vertical cliffs almost 50 feet high.

With respect to occurrence and movement of ground water lithologic units can be grouped into two categories. Deposits of major importance as a source of ground water include clay, silt, and gravel of semi-consolidated Pleistocene marine terrace deposits; silt, sand, and gravel of unconsolidated Recent alluvium and river deposits; and fine-grained sand of the dune area. Deposits of minor importance as a source of ground water include well-consolidated sedimentary and volcanic rocks, Cretaceous to Tertiary in age, that underlie the area west of San Andreas fault and the Franciscan group of Jurassic age east of the fault. A few springs and wells produce limited water from joints and fractures developed in these formations.

Semi-consolidated Pleistocene marine terrace deposits are composed of clay, silt, sand, and gravel that were deposited in littoral and offshore zones of the sea coast during Pleistocene time. The terraces were elevated by later periods of uplift and were dissected by rejuvenated streams. At least two periods of uplift are indicated by the presence of two distinct terrace levels (Plate 6). Streams continue to reduce the size of the terrace remnants.

For greater simplicity terraces are mapped in two groups. Group 1 includes terraces from 50 to 250 feet in elevation and Group 2 includes those between 250 and 500 feet. Terrace remnants exist over 500 feet in elevation, but they have not been mapped because of their small areal extent and isolated location.

A typical section of terrace deposits is exposed on the cliffs facing the ocean west of Gualala; these deposits average approximately 15 feet in thickness, display coloration from tan to buff, and unconformably overlie the Cretaceous Gualala series. During winter and spring months and during brief periods after summer rains, ground water seepage is visible along the contact between the terrace deposits and the underlying bedrock.

The base of the section seen on the sea cliffs consists principally of sandstone pebbles averaging 4 to 6 inches in diameter and it occasionally contains boulders up to 15 inches in diameter. Sand and silt fill the interstices between the pebbles. The sediments are composed of the same material as the underlying Gualala series and were derived by disintegration and erosion of the sandstone mountain ridge to the east. Data obtained from logs of water wells in the Point Arena area indicate that the maximum thickness of the terrace deposits is approximately 35 feet.

A composite log of the terrace deposits is shown below:

Depth in feet	Marine terrace deposits near Point Arena
0 - 5	Topsoil
5 - 20	Soft yellow sand
20 - 30	Soft, caving yellow quicksand
30 - 35	"Point Arena shale" (Gualala series)

Unconsolidated Recent alluvium and stream channel deposits composed of clay, silt, sand, and gravel were deposited on flanks of coastal rivers and creeks. The most extensive deposits are located in valley bottoms of Garcia River, Gualala River and its tributaries, and Brush Creek. The width of alluvial areas averages approximately 0.2 mile but extends to a maximum of 0.75 mile near the mouths of Garcia River and Brush Creek (Plate 6).

Streams erode sediments from mountains to the east and deposit them in river channels and flood plains near the coast. Carrying power of the streams decreases progressively toward their mouths so that coarser sands and gravels are deposited inland, with fine sand, silt, and clay being laid down near the mouths.

Maximum thickness of river deposits is uncertain because no known wells in these deposits penetrate to bedrock. The log of the deepest known well shows that it bottoms in gravel at 56 feet. A composite log of representative material in the river channel deposits is shown below:

Depth in feet	Recent river alluvium and river channel deposits in the Point Arena Costal Area
0 - 20	Soil and silt
20 - 55	River gravel

Sand dunes located between the mouths of Garcia River and Alder Creek are of minor significance as a storage unit for ground water. Aeolian sand has been deposited by prevailing winds from the northwest.

Thickness of terrace deposits reaches a maximum of 35 feet. Yields to wells are low because of thinness of the deposits, cementation of the material, dissection of the terraces, and a relatively steep dip of deposits toward the ocean. Ground water flows directly to the ocean under the resulting steep hydraulic gradient since there are no barriers to prevent escape of ground water.

Most wells in the area penetrate terrace deposits and pierce the underlying bedrock which has been fractured by intense folding and faulting. Wells in terrace material produce a maximum of 3 gpm, whereas wells penetrating the underlying bedrock produce up to 30 gpm under the most favorable conditions. Yields in both terrace deposits and underlying bedrock vary greatly with location.

Recent alluvium and river channel deposits furnish the greatest supply of ground water in the Point Arena area. Wells in the river alluvium yield appreciably larger amounts of water than wells located in terrace deposits. The higher yields result from high permeability of river sand and gravel and high rate of recharge from rivers.

Due to high permeability of sand and lack of hydrologic barriers at the boundaries of the dune area, ground water is not held in the dunes for an appreciable length of time before escaping into the sea.

No extensive or continuous ground water aquifers exist in the Point Arena area.

Water Quality

Streams in the Point Arena Terrace area contain water of excellent mineral quality, suitable for all present beneficial uses. Mineral analyses of surface water are shown in Table 2, Appendix A. Analyses of water from Gualala and Garcia Rivers show a calcium-sodium bicarbonate water with total solids of approximately 135 ppm. Boron concentrations are negligible.

Navarro River contains a calcium-magnesium bicarbonate water with total solids, on the basis of two analyses, of 130 and 158 ppm. Boron concentrations were 0.10 and 0.25 ppm.

There has been little development of ground water in the Point Arena Terrace area. Consequently, only a few samples of ground water were obtained (Table 3, Appendix A). Mineral analyses of these samples indicate that the ground water is generally of good quality and is suitable for most present beneficial uses. The water varies in quality, but is normally a bicarbonate water with varying proportions of calcium, magnesium, and sodium. Total solids are low, usually ranging from 70 to 326 ppm. Boron concentrations are negligible, ranging from 0.00 to 0.16 ppm. However, a mineral analysis of water from one well, 11N/16W-13B1, which is 127 feet deep shows a calcium-sodium chloride water with total solids of 1,010 ppm. Chloride concentration is 530 ppm. This water suggests a derivation in part from sea water. The well, located adjacent to the ocean, extends below sea level, and it is likely that sea water enters fractures in the consolidated rock penetrated by the well.

Minor Valleys

As shown in Table 5, "Ground Water Basins, Mendocino County", a total of 81 minor alluvial areas in Mendocino County were identified in the course of this study.

Fifty minor alluvial valleys have been recognized and delimited in Mendocino County in addition to 31 minor areas included in the discussion of the Fort Bragg and Point Arena Terraces and Contiguous Areas. These vary widely in size and importance. The largest include McDowell Valley near Hopland, Branscomb Valley west of Laytonville (known locally as Jackson Valley), South Fork Eel River Valley in the Piercy-Leggett area, Williams Valley near Covelo, Sherwood Valley west of Longvale, McNab Creek Valley between Ukian and Hopland, Little River Valley northeast of Fort Bragg, and Eden Valley southeast of Covelo. These valleys range in area from about 1.2 to 4.6 square miles. Numerous lesser river terraces and other alluvial areas which scarcely exceed 10 acres in areal extent were also delimited. These are potential sources of limited quantities of ground water. Locations of the minor valleys are shown on Plate 2 and areal geology and locations of wells and sampling points are indicated on Plate 7.

Ground Water Geology and Hydrology

With respect to occurrence of ground water lithologic units in the small valleys can be grouped into two categories. Deposits of major importance as a source of ground water include semi-consolidated clay, sand, and gravel in older alluvium of possible Pleistocene age, in Pleistocene and Recent river terrace deposits, in Recent alluvium, and in Recent channel deposits. Deposits of minor significance as a source of ground water include sedimentary and metamorphic rock units of Jurassic age that underlie and surround all of the alluvial valley areas.

Recent Alluvium, River Channel Deposits, and Terrace Deposits.

Recent alluvium and river channel deposits consist of loose, unconsolidated gravel, sand, silt, and clay. These sediments were deposited in creek or river channels, on flood plains, on alluvial fans at mouths of small creeks tributary to minor valleys, and as hill-slope wash on the margin of some of the valleys. In general, alluvium and river channel deposits are relatively thin and their thickness averages from 10 to 15 feet in the smaller valleys and ranges to over 100 feet in Eden Valley. Alluvium and river channel deposits generally are limited to topographically low areas adjacent to streams. Exceptions are High Valley and Ornbaun Valley which are miniature basins situated near stream divides.

Terrace deposits consist of loose, unconsolidated gravel, sand, silt, and clay, which were laid down in creek or river channels, on flood plains, on alluvial fans, and as slope wash deposited on valley margins at the base of adjacent hills and mountain slopes. Sediments were laid down during Recent and possibly Pleistocene epochs. Subsequent erosion has lowered stream channels to present levels leaving remnants of deposits as discontinuous terraces along the sides of some of the stream valleys. Such terraces are prominantly developed along Van Arsdale Valley north of Van Arsdale Reservoir, along South Fork Eel River at the north end of Branscomb Valley, along South Fork Eel River Valley in the Piecy-Leggett area, along Hollow Tree Creek Valley between Leggett and Rockport, and along both sides of Short Creek in Williams Valley northeast of Covelo. Less prominent terraces have been formed in several of the other minor valleys. Terrace deposits generally are thin, averaging approximately 15 feet in thickness, although total thickness of terraced sediments was estimated to be over 100 feet in a road and stream cut south of Leggett.

Ground water development is minor in all of the small valleys of Mendocino County due to limited agricultural development, low yields, lack of available storage, and in general sufficient surface water to supply the major requirements.

Permeability varies from extremely high in the river gravels to very low in silts and clays. Because of the limited supply of ground water in the deposits and because of availability of water from springs or surface sources, ground water has been developed to only a limited extent in the alluvium and river channel deposits of the minor valleys. Wells drilled in Eden Valley, Ornbaun Valley, and elsewhere have proved unproductive because of low permeability.

Abundance of silt and clay, lack of hyrdrologic barriers on the stream-cut edge of terraces in the minor valleys, and general thinness and limited areal extent of the deposits preclude storage and development of appreciable quantities of ground water from this formation. Wells have been drilled in terrace deposits near Leggett, but production from these is low.

Older Alluvium. Older alluvium of Pleistocene age consists of clay, silt, sand, and gravel deposited on flood plains, on alluvial fans, in river channels, and as colluvial debris and slope wash. Older alluvium may be differentitated from Recent alluvium only by age of deposition and degree of dissection. Sediments classified as older alluvium were deposited contemporaneously with terraces in other valleys but are not classified as such because the topographic form is not that of a terrace. Only in McDowell and McNab Creek Valleys were the water-bearing sediments classified as older alluvium. A driller's log of a water well located near the center of McDowell Valley indicates the total thickness of older alluvium to be over

200 feet. Water-bearing sediments in any of the other minor valleys are not thought to exceed this thickness. Several wells produce ground water from the older alluvium. Production is moderate to low because of the abundance of silt and clay and because of the lack of clean gravel in the formation.

Water Quality

Surface water throughout the minor valleys is of excellent mineral quality. The water is normally a calcium-magnesium bicarbonate type with low total solids (Table 2, Appendix A). Samples for mineral analysis were not obtained in many of the minor valleys, since major streams such as Eel River, from which samples were previously obtained, are available and because the importance of runoff from many of the small valleys was not deemed sufficient to permit extensive sampling. However, without exception, mineral analyses of surface waters showed low total solids with no high concentration of individual constituents.

Ground waters were not sampled in most of the smaller valleys because of the minor importance of these areas as a source of water supply. However, results of the few samples obtained indicate the water is normally a calcium-magnesium bicarbonate water with low total solids (Table 3, Appendix A).

CHAPTER III. PRESENT WATER WELL CONSTRUCTION AND SEALING PRACTICES

Prior to formulating requirements or making recommendations regarding water well construction and sealing practices necessary for protection of ground water quality, consideration should be given to the following:

(1) The basic reasons or objectives leading to a particular recommendation regarding construction of a water well or sealing of an abandoned well;

(2) recommendations of recognized authorities and organizations regarding methods to be employed; and,

(3) present practices in Mendocino County.

Numerous factors influence accomplishment of the basic objective of proper water well construction and sealing practices. This objective is the prevention of impairment of ground water quality due to entrance of foreign material into the well or due to intermingling of inferior waters with waters of satisfactory quality in the well shaft. Major factors influencing accomplishment of this basic objective include: geologic, hydrologic, and water quality conditions; location of wells with regard to sources of degradation; and methods and materials utilized for construction or abandonment. A reveiw of these factors as they pertain to construction and abandonment of water wells in Mendocino County is presented in this chapter.

Publications of numerous agencies concerned with water well construction such as American Water Works Association, American Society of Civil Engineers, and federal, state, and local health authorities, have been reviewed; certain portions thereof which relate to specific features of water well construction and abandonment are cited in this report.

Data and information regarding well locations and methods and materials utilized in the construction and abandonement of water wells were obtained from field surveys and from interviews with water well drillers. Most of the data were obtained by visual inspection; however, in some cases additional subsurface information was obtained from water well drillers and well owners.

Water well drillers currently operating or known to have operated in Mendocino County were interviewed to obtain specific information regarding present materials and methods employed by the drillers and to obtain their recommendations for materials and methods necessary to insure reasonable protection of ground water quality.

Factors Affecting Well Construction and Sealing

Geologic, hydrologic, and water quality conditions have a direct bearing upon methods necessary for proper water well construction and for sealing of abandoned wells to protect the quality of ground waters.

Three general geologic conditions influence water well construction in Mendocino County:

(1) Water-bearing material overlying impermeable strata.

(2) Water-bearing material overlain by impermeable strata.

(3) Fractures, fissures, or channels in otherwise impermeable strata.

The first condition, where water-bearing materials overlie impermeable strata, occurs most often in alluvial areas of Mendocino County. Well construction in these areas must insure that surface or near-surface waters will not be permitted to flow directly to the underlying ground water body through either active or abandoned water wells. It is thus apparent that the location of the well with respect to possible sources of contamination, pollution, or degradation is of great importance, as are the actual construction features of the well itself. The ability of formation materials located above the water table to exclude or filter contaminating material before it reaches the water table is of paramount importance in determining proper location of wells. Many alluvial areas in Mendocino County exhibit shallow water table conditions in combination with only a small thickness of saturated materials. In these cases it is particularly difficult to prevent surface or near-surface contamination from entering the well, since the well generally is shallow and is perforated throughout the entire water-bearing zone in order to obtain the necessary quantity of water. Therefore the well should be adequately protected against downward migration of water around the casing and should be adequately covered at the top to prevent entrance of surface water into the well casing.

In some areas of Mendocino County alluvial material is underlain by consolidated material which contains water of inferior quality. These poor quality waters migrate upward through faults, fissures, or fractures in the intervening material and may endanger quality of water in overlying alluvial materials. When such inferior waters are found, it is necessary to seal off the zone in which these waters originate.

In a few areas of Mendocino County water-bearing materials are overlain by impermeable strata such as clays and silts. In these areas ground water is often confined by the overlying impervious material and is under pressure. If the water level in a well rises above the lower edge of the confining materials, it indicates that pressure conditions exist. In these areas the relationship between the location of the well and the sources of surface contamination assumes lesser importance because of the physical separation between the sources of contamination and the ground water; details of well construction then assume greater importance. Under these circumstances it is necessary that the casing be watertight where it passes through the confining member. Watertightness is especially important since the well provides a potential means for surface water or shallow ground water to enter directly into the confined aquifer.

Perched waters or shallow ground waters that occasionally occur on top of confining members are of particular significance since they are frequently highly mineralized as a result of leaching of salts or percolation of wastes through the overlying soils and subsequent concentration of these waters through evaporation. These perched or shallow ground water conditions are frequently aggravated because of restricted lateral movement. Adequate sealing of abandoned wells in confined aquifers is of great importance both for protection of water quality and for prevention of waste of confined water and prevention of reduction of available hydrostatic pressure. Wastage of artesian waters is specifically prohibited by the Water Code (Sections 300-311). To seal an abandoned well penetrating a confined aquifer, the opening in the confining member should be sealed with material equally as impervious as the confining formation.

Impermeable materials consisting primarily of unconsolidated rocks of the Franciscan formation surround and underlie all of the inland alluvial area of Mendocino County and underlie and partially surround the coastal areas. Throughout these impermeable materials occur fractures, fissures, and channels which contain ground water. Development of ground water from these sources is very uncertain in respect both to quality and quantity. These waters are frequently highly mineralized. The degree of filtration against contamination afforded by these fissures, fractures, and channels is uncertain. Therefore under these conditions care must be exercised in the location of wells with respect to possible sources of pollution and contamination.

When mineralized waters are found, they should not be discharged or permitted to flow into surface water courses or into alluvial ground water areas.

Well Location

Location of a well with respect to topographic, geologic, and hydrologic conditions, and possible sources of water quality impairment is of major importance in protection of ground water quality.

The well should be located above the normal flood level and should be located on high ground so that surface water drains away from the well. If such location is not possible, adequate means should be provided to conduct surface water away from the well. To provide maximum distance for filtration through overlying material, the well should be located as far as possible from such sources of contamination as septic tanks, cesspools, seepage pits, and barnyards. Safe distance from sources of contamination varies with the character of the source, permeability of overlying materials, depth to ground water, and the sanitary features of well construction. Wells should be located much farther from sources of contamination in those areas in which material overlying the water table is coarser and more pervious then in areas in which overlying material is composed of clay or other fine-grained material. Horizontal distance from sources of contamination should be increased in shallow ground water areas. Shallow dug wells should be located farther from sources of contamination than should deeper drilled wells which are unperforated near the surface.

Wells should be located to take advantage of known geologic conditions which would inhibit or prevent movement of inferior quality surface or near-surface water to the source of water supply for the well. The well should be located up the slope of the water table from sources of impairment so that any deleterious material from such sources which reach the water table is carried away from the well. In this regard it may be well to note that the normal direction of ground water movement may be altered by withdrawal of water from the proposed well or altered by the influence exerted by other pumping wells.

The United States Public Health Service (32) recommends that the distance from the source of water supply to any source of contamination in all horizontal directions should not be less than 50 feet and that greater distances should be provided where local conditions indicate the need for greater protection. Minimum distances from dug or bored wells recommended by the Federal Housing Administration (17) vary from 50 feet for septic tanks to 200 feet for cesspools. The Joint (Federal) Committee on Rural Sanitation (7) specified minimum distances ranging from 25 feet for pit privies to 150 feet for cesspools.

Generally, present practice in Mendocino County is to locate the well a certain minimum distance from sources of contamination, a distance which varies among the drillers. Most of the drillers operating in Mendocino County recommended that the well be located a minimum of 50 feet from sources of contamination. The remainder recommended a minimum ranging from 75 to 100 feet.

Most of the drillers stated that they attempt to locate a well on a topographic high in order to prevent surface drainage from flowing toward the well and to reduce the possibility of flooding. However, field inspections indicated that ground surface sloped toward 75 per cent of the wells surveyed and that about 20 per cent of the wells were subject to flooding.

Well Construction Practices

A total of 491 of the estimated 4,000 water wells in Mendocino County were inspected to determine the use of the well, methods and materials of construction, and present sanitary condition. These wells were also inspected to determine whether present methods and materials of construction are adequate to prevent mineral or bacterial degradation of ground water. This survey was designed to inspect a sufficient number of wells to give an indication of present construction practices in each of the ground water basins in Mendocino County. A summary of results of the field survey is subdivided into groups representing each ground water basin and is presented in Table 7. These results are also expressed as percentages to facilitate comparison of the data presented.

Results of the well construction survey show that more than 50 per cent of the wells surveyed are less than 50 feet in depth and only 5 per cent are deeper than 200 feet. Forty-four per cent were dug wells. These shallow depths and the methods of construction result from the generally shallow nature of the alluvial material, from a shallow ground water table, and in many cases from a need for a water supply sufficient only to satisfy domestic and minor agricultural requirements. Where quantity requirements are low and use is intermittent, dug wells of large diameter have been constructed in relatively low water yielding material to take advantage of storage in the well shaft.

With few exceptions the casings of dug wells have been constructed of inadequate materials and with little regard for proper construction practices. Casings of drilled wells are usually of sufficient strength and

TABLE 7

WATER WELL CONSTRUCTION SURVEY
MENDOCINO COUNTY

Survey Item	AREA																					
	Mendocino County		Anderson Valley (1-19)		Hopland Valley (1-16)		Laytonville Valley (1-12)		Little Lake Valley (1-13)		Potter Valley (1-14)		Round Valley (1-11)		Ukiah Valley (1-15)		Fort Bragg Terrace (1-21)		Point Arena Terrace (1-20)		Minor Valleys	
	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent
Total Wells Surveyed	491	—	45	—	47	--	39	--	41	—	60	—	64	—	119	—	43	—	25	—	8	—
Depth (Feet)																						
0 - 50	267	54	15	33	25	53	26	67	23	56	40	67	9	14	68	57	41	95	14	56	6	75
50 - 200	199	41	30	67	18	38	9	23	15	37	18	30	44	68	50	42	2	5	11	44	2	25
Greater than 200	25	5	0	0	4	9	4	10	3	7	2	3	11	17	1	1	0	0	0	0	0	0
Diameter (Inches)																						
6	58	12	11	25	1	2	2	5	7	17	4	7	16	25	9	8	2	5	6	24	0	0
8	115	23	18	40	8	17	12	31	10	24	17	28	20	31	20	17	1	2	7	28	2	25
10	22	5	0	0	2	4	4	10	2	5	3	5	5	8	6	5	0	0	0	0	0	0
12	75	15	2	4	20	43	2	5	4	10	9	15	19	30	17	14	1	2	1	4	0	0
Greater than 12	221	45	14	31	16	34	19	49	18	44	27	45	4	6	67	56	39	91	11	44	6	75
Type of Construction																						
Dug	217	44	14	31	16	34	19	49	18	44	27	45	1	2	67	56	39	91	11	44	5	62
Drilled	274	56	31	69	31	66	20	51	23	56	33	55	63	98	52	44	4	9	14	56	3	38
Rotary	38	8	7	16	2	4	2	5	4	10	1	2	18	28	2	2	0	0	2	8	0	0
Cable	236	48	24	53	29	62	18	46	19	46	32	53	45	70	50	42	4	9	12	48	3	38
Natural Drainage																						
Toward well	367	75	36	76	37	79	30	77	30	73	35	58	38	59	92	77	41	95	20	80	8	100
Away from well	124	25	9	24	10	21	9	23	11	27	25	42	26	41	27	23	2	5	5	20	0	0
Subject to flooding	95	15	0	0	17	36	8	21	14	34	15	25	10	16	27	23	1	2	2	8	1	13
Flow of surface or ground water from source of pollution to well	330	67	31	69	27	57	36	92	34	83	46	77	60	94	63	53	15	35	13	52	5	62
Floor Drainage																						
Toward well	245	50	21	47	29	62	22	56	13	32	28	47	25	39	66	55	23	53	10	40	8	100
Away from well	124	25	16	36	8	17	9	23	12	29	14	23	15	23	33	28	7	16	10	40	0	0
Undetermined	122	25	8	17	10	21	8	21	16	39	18	30	24	38	20	17	13	30	5	20	0	0
Surface Construction																						
Type of Pump Platform																						
Wood	184	38	10	22	17	36	15	38	13	32	28	46	14	22	46	39	25	58	10	40	6	75
Concrete	83	17	9	20	6	13	1	3	7	17	12	20	15	23	23	19	5	12	4	16	1	25
Metal	15	3	1	2	1	2	1	3	1	2	6	10	3	5	1	1	0	0	1	4	0	0
Mounted on casing	46	9	5	11	5	11	4	10	1	2	4	7	10	16	14	12	1	2	2	8	0	0
None	163	33	20	45	18	38	18	46	19	47	10	17	22	34	35	29	12	28	8	32	1	25
Type Seal Between Platform and Casing																						
Concrete	77	16	8	18	6	13	4	10	2	5	2	3	18	28	27	23	6	14	3	12	1	12
Wood	9	2	2	4	2	4	0	0	1	2	0	0	0	0	4	3	0	0	0	0	0	0
Metal	6	1	0	0	0	0	0	0	1	2	0	0	1	2	3	3	1	2	0	0	0	0
Welded	2	0	0	0	0	0	0	0	0	0	1	2	1	2	0	0	0	0	0	0	0	0
Bolted	1	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0
None	396	81	35	78	39	83	35	90	37	91	56	93	44	68	85	71	36	84	22	88	7	88

TABLE 7

WATER WELL CONSTRUCTION SURVEY
MENDOCINO COUNTY
(continued)

Survey Item	Mendocino County		Anderson Valley (1-19)		Hopland Valley (1-16)		Laytonville Valley (1-12)		Little Lake Valley (1-17)		Potter Valley (1-14)		Round Valley (1-13)		Ukiah Valley (1-15)		Fort Bragg Terrace (1-21)		Point Arena Terrace (1-20)		Minor Valleys	
	AREA																					
	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent	Number of wells	Per cent
Surface Construction (cont'd)																						
Seal Between Pump Base and Casing																						
Open	318	65	17	38	34	72	30	77	31	76	43	72	33	52	79	66	33	77	11	44	7	88
Watertight	173	35	28	62	13	28	9	23	10	24	17	28	31	48	40	34	10	23	14	56	1	12
Casing																						
Material																						
Steel	268	54	30	67	31	66	19	48	17	42	32	53	59	92	60	50	4	9	14	56	2	25
Hard red	11	2	1	2	0	0	1	3	3	7	4	7	1	2	1	1	0	0	0	0	0	0
Blue annealed	11	2	0	0	0	0	2	5	1	2	3	5	5	8	0	0	0	0	0	0	0	0
Unknown	246	50	29	65	31	66	16	40	13	33	25	41	53	82	59	49	4	9	14	56	2	25
Other metal	6	1	2	4	1	2	1	3	0	0	1	2	0	0	0	0	1	2	0	0	0	0
Concrete	88	18	5	11	4	8	7	18	1	2	5	10	2	3	30	25	24	57	7	28	2	25
Brick	51	10	3	7	5	11	4	10	9	22	13	22	0	0	14	12	3	7	0	0	0	0
Stone	13	3	0	0	1	2	2	5	1	2	2	3	0	0	4	3	1	2	1	4	1	12
Wood	27	6	4	9	5	11	2	5	0	0	3	5	0	0	2	2	8	19	1	4	2	25
None	13	3	1	2	0	0	3	8	4	10	0	0	0	0	2	2	1	2	2	8	0	0
Unknown material	25	5	0	0	0	0	1	3	9	22	3	5	3	5	7	6	1	2	0	0	1	13
Condition																						
Good	249	51	22	49	27	58	23	59	15	37	31	52	24	37	65	55	24	56	12	48	6	75
Fair	23	5	3	7	2	4	1	3	1	2	2	3	1	2	3	2	6	14	4	16	0	0
Poor	39	8	2	4	7	15	2	5	3	7	5	8	10	16	7	6	2	5	1	4	0	0
Unknown	180	36	18	40	11	23	13	33	22	54	22	37	29	45	44	37	11	25	8	32	2	25
Type of Joint																						
Welded	111	23	15	34	13	28	9	23	12	30	18	30	7	11	25	21	2	5	9	36	1	12
Riveted	47	10	4	9	7	15	2	5	1	2	4	7	14	22	15	13	0	0	0	0	0	0
Unknown	333	67	26	57	27	57	28	72	28	68	38	63	43	67	79	66	41	95	16	64	7	88
Termination of Casing																						
Above platform	419	85	41	91	42	89	32	82	28	68	46	77	58	91	102	86	38	88	25	100	7	88
Below platform	72	15	4	9	5	11	7	18	13	32	14	23	6	9	17	14	5	12	0	0	1	12
Depth Cased																						
Full	323	66	22	49	36	77	28	72	23	56	46	77	43	67	66	56	36	84	18	72	5	62
Partial	23	5	2	4	2	4	4	10	3	7	3	5	2	3	4	3	2	5	1	4	0	0
Unknown	145	29	21	47	9	19	7	18	15	37	11	18	19	30	49	41	5	11	5	24	3	38

of proper materials; however, their ability to perform their proper functions has often been seriously impaired by improper construction of joints and perforations or other inadequate construction practices.

The majority of wells surveyed do not have adequate pump platforms or surface seals.

According to the results of the field survey, a majority of the drilled wells in Mendocino County were constructed by the cable tool method. Most established drillers in the area are not familiar with the rotary method and most of the wells so drilled have been constructed by drillers from outside the county.

Methods and materials used in construction of these various types of wells, as they relate to protection of ground water quality, are discussed in the following paragraphs.

Drilling Methods

Wells commonly constructed in Mendocino County are classified by method of construction as drilled or dug. Drilled wells may be further classified as rotary or cable tool according to the type of equipment used to drill the well. Of the wells canvassed, 56 per cent were drilled and the remainder dug. Eighty-six per cent of the drilled wells were by cable tool and fourteen per cent by the rotary method.

A brief description of each of these methods of water well construction is given in the following paragraphs.

Drilled Wells. Drilled wells are constructed with portable well drilling machines by either the rotary or cable tool method. The cable tool or percussion method employs a string of tools suspended from a cable. A heavy bit, alternately raised and dropped, breaks up the material at the bottom of the hole into small fragments. The reciprocating motion of the drilling tools in the presence of water mixes the loosened material into a sludge which is removed from the hole at intervals by a scow, bailer, or sand pump. Since the drill is smaller than the casing, the casing must be driven or forced into the hole. In most unconsolidated formations the casing is driven as the hole is drilled to prevent caving.

Rotary drilling requires a cutting tool or bit, a shaft for transmission of rotation to the bit, a means for maintaining bit pressure against the material being cut, a power source to operate the various pumps and rotate the bit, and generally a mud-laden fluid. The mud-laden fluid is pumped through the drill pipe and out through an opening in the bit. The fluid then rises to the surface through the space between the drill pipe and the walls of the hole. The fluid carries the drill cuttings from the hole and also exerts pressure against the formations that have been penetrated. Usually it is not necessary to install casing until drilling is completed. This method of drilling can be used for either shallow or deep wells and for wells that require gravel packing because it is not difficult to construct a large diameter hole. The hole is normally constructed slightly larger in diameter than the desired casing which may then be perforated in the desired intervals, joined, and lowered into the hole without appreciable driving.

Drilled wells may be constructed to depths of several thousand feet if desired. The deepest well found during our survey was 1,100 feet deep. Diameters usually range from 6 to over 24 inches, although in Mendocino County few drilled wells are over 12 inches in diameter.

Proper development of the well is necessary to produce the maximum amount of water with a minimum drawdown, to reduce sanding, and to lengthen the economic life of the well. Development consists of some method of rapidly moving water from the formation into the casing and then reversing flow. This procedure sorts the formation material and results in the removal of fine material from near the casing. Methods of development include the use of compressed air, alternately starting and stopping a test pump, or overpumping the well to draw the fine material into the well whence it may be withdrawn by the test pump, bailer, or sand pump.

Artificial gravel packing is sometimes necessary to develop a satisfactory yield of water from formations composed of fine materials. Gravel packing generally consists of the introduction of gravel between the water-bearing formation and the well casing. Purposes of gravel packing include expanding the area of contact between the water producing zone and the well shaft, reducing the velocity of water entering the well with consequent reduction of the amount of fine materials carried into the well, decreasing the drawdown, and increasing the capacity. Gravel-packed wells may be drilled by either the rotary or cable tool methods. The gravel-packed well offers many advantages when used under proper conditions; however, each method of gravel packing has its limitation and should be used carefully. Determinations of proper conditions for gravel-packed well construction as well as the correct intervals to be gravel-packed and the size of gravel needed should only be made by properly qualified persons.

Dug Wells. Dug wells are generally larger in diameter and not as deep as drilled wells. They may be either circular or rectangular in plan, and are usually excavated with hand tools. To prevent caving they are usually cribbed or cased during construction. Casing may consist of concrete, brick, steel, or wood cribbing. Due to the method of excavation dug wells are seldom less than three feet in diameter, and diameters of 10 or 15 feet may be necessary in formations which yield water slowly. Dug wells are not often constructed to any appreciable distance below the water table since construction is commonly by hand excavation and it is difficult to dewater the excavation. Depth is also limited by the difficulty of raising excavated material to the surface. For these reasons dug wells in Mendocino County are seldom over 35 feet in depth. Because of the method of excavation dug wells may often be constructed by the owner without appreciable cash outlay and are therefore often favored over drilled wells in areas where construction is feasible. Adequate construction of dug wells is less often obtained than in drilled wells because they are usually constructed by persons not familiar with the reasons for proper well construction methods or the reasons for using adequate materials. Dug wells are commonly used to furnish a relatively large supply of water from shallow sources.

Casing

The main functions of well casings are to seal out contaminated water or other undesirable water, to hold out loose materials, and to prevent caving. Casing permits utilization of aquifers yielding waters of suitable quality by selective perforation, and can be used as a means to prevent entrance of undesirable water into the bore hole.

Casing must be selected which will perform satisfactorily under the forces which act upon it. These forces include installation stresses; static forces imposed by soil, water, and weight of pump; and the corrosive and electrolytic action of the waters. Casing material must be capable of being joined in a watertight column, and it must be capable of being perforated at any desired interval.

Material. Steel is the most common casing material used in drilled wells. Steel used in cable tool wells must withstand being driven and must be easily welded unless screw joints are used.

Single-wall and double-wall pipe manufactured specifically for water well casing are commonly used in drilled wells. Double-wall water well casing is commonly known as California stovepipe. This type of casing is constructed of two concentric single casings placed together by telescoping one cylindrical section half way along another thus staggering the joints.

Required thickness of steel casing depends on forces imposed during and after placement, casing diameter, and chemical and physical properties of the steel. As depth and diameter of the well increase, additional forces are imposed upon the casing, necessitating corresponding increases in the thickness of a given material. Thicker casings may be required in areas where corrosive ground waters are found or where there are pronounced electrolytic effects.

The United States Public Health Service (32) recommends that metallic casings be new standard steel, wrought-iron, or cast-iron. The Federal Housing Administration (17) states that only standard weight wrought-steel or wrought-iron well casing shall be used in drilled wells.

The American Water Works Association (1) states that in the selection of casing it is necessary to consider the strain to which the pipe will be subjected during the installation and the corrosiveness of the water with which it comes in contact. Cast-iron pipe, copper pipe, and pipe with a non-tenacious shatterable lining should not be driven; however, they are known to be corrosion resistant and deserve consideration when the casing may be set in place. Wrought-iron and steel pipes have given satisfactory service in many locations, wrought-iron being preferred occasionally for protection against corrosion.

Hard red steel pipe was the predominant material recommended for use as casing by the drillers in the county. (Hard red steel is no longer produced. This product is now manufactured under the trade name of "Kaiwell" casing.)

Many of the local drillers recommended a minimum steel casing thickness of 12 gage U. S. standard. Others recommended from 14 gage to 3/8 inch. All but one driller interviewed stated that they use only single-wall casing in Mendocino County. Two major casing manufacturers indicate that 12 gage is the minimum size casing they normally fabricate for both single-cased and double-cased wells.

The following tabulations are summary compilations of minimum thickness of water well casing obtained from:

(1) Application of a number of engineering formulas which allow for the various forces which might be imposed,

(2) recommendations of several pipe and water well casing manufacturers, and

(3) recommendations of water well drillers in Mendocino County.

MINIMUM THICKNESS FOR STEEL
WATER WELL CASING FOR DRILLED WELLS
SINGLE CASING

Depth of casing in feet	Diameter, in inches										
	6	8	10	12	14	16	18	20	22	24	30
					Thickness*						
0 - 100	12	12	12	10	10	8	8	8	8	8	3/16
100 - 200	12	12	10	8	8	8	3/16	3/16	3/16	3/16	1/4
200 - 300	10	10	8	8	8	3/16	3/16	3/16	1/4	1/4	1/4
300 - 400	10	8	8	3/16	3/16	3/16	1/4	1/4	1/4	1/4	5/16
400 - 600	10	8	3/16	3/16	3/16	1/4	1/4	1/4	5/16	5/16	5/16
600 - 800	3/16	3/16	3/16	3/16	1/4	1/4	1/4	5/16	5/16	3/8	3/8
over- 800	3/16	3/16	3/16	1/4	1/4	1/4	5/16	5/16	3/8	3/8	7/16

*Values above diagonal are U. S. standard gage.
Values below diagonal are thickness in inches.

MINIMUM THICKNESS FOR STEEL
WATER WELL CASING FOR DRILLED WELLS
DOUBLE CASING (CALIFORNIA STOVEPIPE)

Depth of casing in feet	Diameter, in inches								
	10	12	14	16	18	20	22	24	30
	Thickness*								
0 - 100	12	12	12	12	10	10	10	10	8
100 - 200	12	12	12	10	10	10	10	8	8
200 - 300	12	12	10	10	10	10	8	8	8
300 - 400	12	12	10	10	10	8	8	8	8
400 - 600	10	10	10	10	8	8	8	8	8
600 - 800	10	10	10	8	8	8	6	6	6
over- 800	10	8	8	8	6	6	6	6	6

*Values are U. S. standard gage.

Concrete, brick, or wood liners are commonly used for casings in dug wells while steel casing is occasionally used. Wood is unsatisfactory for use as casing since it cannot be made watertight initially and is subject to rather rapid deterioration. Brick and building blocks do not always provide a permanently watertight casing. Concrete casings are satisfactory if properly constructed.

Concrete casing may either be poured in place or it may consist of precast concrete rings. To be satisfactory the poured-in-place concrete must be sufficiently strong to withstand the soil and water pressures imposed on it. It should be properly reinforced with steel to furnish tensile strength and resist cracking which would impair its watertightness. Aggregate used in the concrete should be small enough to insure proper placement without bridging. The finished product should be free from honeycombing or other defects likely to impair the ability of the structure to remain watertight.

Precast concrete casing is commonly composed of concrete rings from 3 to 5 feet in diameter and approximately 3 feet in length. To serve satisfactorily as casing, such rings should be free of any blemishes which would impair their strength or watertightness.

The Federal Housing Administration (17) states that casing construction shall be permanently watertight to a depth of at least 10 feet below ground surface and that casing below the watertight construction in dug wells shall be of concrete, terra cotta, brick, sheet metal, or other material strong and durable enough to maintain the opening and withstand the loads imposed.

The United States Public Health Service (32) recommends that vitrified-tile pipe, cement-asbestos pipe, galvanized well casing, corrugated-metal pipe, and concrete pipe shall be surrounded by not less than six inches of concrete to a depth of at least 10 feet. The surrounding wall shall be reinforced and the concrete shall be placed so as to be free from voids.

Casing material in 31 per cent of the wells canvassed in the county were of concrete, brick, or stone. About six per cent were wood and three per cent had no casing at all.

Placement. Permanent casing should be placed in all wells to a safe depth below ground surface to prevent contaminated water or foreign material from entering the well. Proper placement of casing is a requisite to good well construction. Casing should be placed with care to avoid damage.

More care is probably required in placement of casing in a well drilled by the cable tool method than by the rotary method, since in the former the bore hole is usually smaller than the casing to be driven. This necessitates driving casing with considerable force. To avoid damage to casing during installation in cable tool wells a suitable drive shoe is generally necessary. The casing is "landed" or seated in a suitable formation to provide an adequate footing. Usually these formations consist of bedrock, clays, or gravels. When such formations are not encountered, cement grout is often placed in the bottom of the hole. The casing is then raised slightly and then lowered to properly seat the casing in the grout.

When concrete casing is used in dug wells, the casing must rest upon an adequately designed footing or platform to prevent foundation settlement which would cause cracking and failure of the casing. To reduce the possibility of honeycombing or separation of material, concrete poured in place should not be allowed free fall.

The United States Public Health Service has found that proper construction and installation of watertight casing or curbing is essential to prevent entrance of surface or subsurface contamination into the well.

The Federal Housing Administration regulations (17) provide that a true vertical shaft shall be obtained with no damage to the pipes or joints in drilled wells and no damage to the lining in dug wells. They also state that when the lower extremity of casing in a drilled well is to be sealed in an impervious formation above the water table, it shall be properly seated and sealed to shut-off effectively all undesirable ground water.

The American Water Works Association (1) states that well casings and liners have the dual purpose of sealing out contaminated and other undesirable water and of maintaining the opening from the surface to the water-bearing formations. To be wholly effective the casing and liners should be constructed of suitable materials and be so installed as to accomplish their intended purpose.

With regard to installing casing the entire depth of the well, most of the drillers interviewed in Mendocino County stated that they case the entire depth of the well under all conditions; whereas, some of the drillers case the entire depth only when caving sand is found or to prevent possible collapse of the well.

Diameter Reduction. Casing diameter may be reduced one or more times at successive depth intervals to economize on cost of casing, to permit grouting the larger casing in place, or to permit driving casing to greater depths when the larger casing cannot be driven farther. This practice is commonly called "telescoping". Unless the space between the two casings is sealed this practice leaves a direct opening into the well. Good practice dictates that the two casings be overlapped a suitable distance, and that an impermeable seal be placed in the annular space between them. The seal may consist of cement grout, neat cement, or a suitable packer. The sealing procedure should eliminate any space in which water may move freely between the casings or where foreign material may collect.

Dug wells are sometimes reduced in size as the hole progresses downward. In these cases it is extremely difficult to seal the intervening annular space.

The United States Public Health Service (32) has recommended that telescoping casing of different diameters in a drilled well overlap at least eight feet and that the annular space between such casings be not less than 1-1/2 inches. The resulting annular space should be filled with impervious cement grout or with a lead packer to prevent admission of undesirable ground water or surface drainage.

Available data indicates that casing diameters are reduced in only a small percentage of the wells in Mendocino County. Reductions are shown for only 14 of over 500 wells for which data are presented in Table 1, Appendix A. Eight of the 14 were drilled wells, whereas the others were either dug or a combination of dug and drilled.

Joints. Sections of steel casing can be joined to make a watertight seal by the use of threaded couplings, by butt welding the section completely around the circumference, or by a slip collar welded around the circumference at both ends of the collar. California stovepipe casing may be joined by welding the outside section completely around the circumference and welding the outer section to the inner casing through holes made in the outer casing for this purpose. If properly done this creates a watertight joint. California stovepipe casing is sometimes joined by hitting the outer casing a series of blows around the periphery with a heavy, sharp pointed tool which crimps the inner and outer casing together and joins the sections. This method of joining may not create a watertight casing.

The United States Public Health Service (32) states that a watertight well casing or curbing should extend as far as practicable below the natural ground level but not less than 10 feet below the ground surface and preferably 10 feet below the ground water table. If metallic casings are used, the pipe sections should be threaded or welded so as to be watertight.

The California State Department of Public Health (8) recommends that sanitary well construction include building the casing or walls of the well watertight without perforations to a depth several feet below the lowest ground water table and also below the lowest sewer wells in the vicinity, and preferably into clay.

The Federal Housing Administration (17) requires that construction of drilled wells shall be permanently watertight from a safe elevation (at least two inches) above the concrete slab at the surface or pump room floor, to an impervious formation, if one exists above the water-bearing formation. If an impervious formation does not exist, construction should be watertight to a safe depth (at least 15 feet) below the future maximum drawdown of the water in the well. In all cases the drilled well shall have a watertight lining to a point at least 10 feet below the natural ground surface and to greater depths if necessary to exclude surface water or undesirable ground water.

The American Water Works Association (1) states that for casings used for protection against contamination, the joints should be welded or made with threaded couplings. The string of pipe used as the protective casing in a well should be continuous with tight joints from its bottom terminal to a height above the ground sufficient to assure adequate surface protection.

Most of the drillers interviewed in Mendocino County use butt welded joints only. The majority of these drillers recommended watertight joints the entire length of the casing. Other recommendations were watertight joints to (a) the perforations in the casing, (b) a depth of 30 feet below ground surface, and (c) a depth of 50 feet below ground surface. One driller stated that watertight casing was not necessary in water-bearing zones.

Separate precast concrete rings, frequently used for casings in dug wells, are usually placed together using cement mortar composed of sand, cement, and water. Care is essential in placement to insure that these joints are watertight.

When concrete casing is poured in place it is necessary to pour as much as possible at one time in order to avoid construction joints.

Even though construction joints are adequately cleaned it is difficult to make a watertight seal.

The United States Public Health Service (32) recommends that when concrete pipe, vitrified-tile pipe, cement-asbestos pipe, galvanized pipe, corrugated-metal pipe, or brick are used for casing wells, these pipes shall be surrounded by not less than six inches of concrete to a depth of at least 10 feet. The surrounding concrete wall shall be properly reinforced and placed so as to be free from voids. Wherever practical the wall shall be poured in one operation, but in no case shall there by a construction joint within 10 feet of the top of the curbing. Where construction joints are essential at points more than 10 feet below ground surface they shall be left rough and shall be washed and brushed with neat cement grout prior to pouring concrete.

The Federal Housing Administration (17) requires that construction of dug wells shall be permanently watertight from a point 14 inches above the ground surface to a depth of 10 feet below the natural ground surface, and to greater depths (at least two feet below the zone of pollution) where subsoil conditions may permit infiltration of surface water of undesirable quality. Watertight concrete casing should be not less than six inches thick and shall be poured in one continuous operation.

Construction of joints in many of the dug wells included in the field survey appeared to be unsatisfactory. Many of the dug wells had no casing and or casing constructed of wood, stone, or loose brick.

In consideration of the references cited above and the recommendations of the well drillers, we believe conditions in Mendocino County require that all wells should extend to a minimum depth of 15 feet below natural ground surface and should be lined with permanent casing joined in a watertight manner at least to that depth. This minimum depth of watertight joints will help prevent movement of surface and near-surface water through the casing thence into the shallow ground water present in most of the developed areas throughout the county.

Perforations. If the casing extends the entire depth of the well, provisions must be made for water to enter the well column through the casing wall at levels where water-bearing strata are found.

Usually water is admitted to the well through perforations or openings in the casing wall. Essentially the optimum area of openings in the casing will provide entrance for the maximum amount of water and exclude fine-grained sediments without weakening the casing beyond its ability to withstand the combined forces imposed upon it. It should be noted that many problems of sanding can be solved or limited by proper well development, pump capacity and size, and type of perforations as well as by limiting the area of perforations. Contamination percolating to ground water tends to remain near the upper portion of the ground water body rather than to diffuse throughout the ground water body. To help prevent entrance of undesirable water the casing should be perforated as far below the water table as practical and should be watertight above the uppermost perforations.

Various methods used in perforating casings include factory methods, torch-cutting, and in-place perforating. Perforating by factory methods, as the name implies, is done in the shop. Milled, punched, and chiselled perforations are made in the factory. Milled perforations are made by milling out portions of metal in the casing as desired. This method does not tear or deform the casing. Punched or louvered perforations consist of horizontal or vertical slots made by insertion of a tool inside the casing which deforms the casing material into a predetermined shape. Torch-cut perforations are made either in the factory or in the field by burning out slots with an acetylene torch. Torch-cut perforations also involve removal of material without deformation of the casing. In-place perforations are made after the casing is placed in the well. They are widely used in cable tool wells in which the casing is placed as drilling progresses and the location for perforations cannot be determined until the entire casing is in place. There are several methods of making in-place perforations. The most common is with a series of projections or knives which are expanded against the inside of the casing where perforations are desired and contracted after perforations are made.

C. F. Tolman (21) states that it is difficult to control satisfactorily the size and spacing of the slots made by the in-place perforating machine. If a pumping test indicates incomplete perforations, a second use of the cutter will probably result in over-perforation and is almost sure to tear or rip the casing. In many cases old casing has been pulled from wells in which holes as big as a man's fist were torn by faulty action of the cutter blades. Such oversize holes may cause collapse of the casing soon after its perforation. On the other hand, with care and good equipment, perforation of casing in place is often satisfactory.

An exception to the wells in which perforated casing is required is the open bottom well. In this type well, casing is not used in the water-bearing formation since the formation will stand without caving or sloughing.

Many dug wells function as open bottom wells. However, in some cases it is necessary that the casing be perforated in order to obtain an adequate supply of water. Dug well perforations commonly consist of especially perforated concrete sections or of spaced building blocks. Perforations in steel casings for dug wells usually consist of slots cut by acetylene torch.

The California State Department of Public Health (8) states that for sanitary construction of cased wells the casing or walls of the well should be built without perforations to a depth several feet below lowest ground water table, and also below lowest sewer wells in the vicinity, and preferably into clay.

Results of interviews with drillers operating in Mendocino County indicate that about one-third use pre-perforated casings, one-third prefer to perforate in-place, and the remainder use both methods. The practices presently employed for making perforations in dug wells were not determined.

Ground Water Sampling

In the course of drilling, rebuilding, or repairing a well, water-bearing zones of different quality may be encountered. If the comparative quality of the waters is such that commingling could have a detrimental effect on any of the waters encountered, measures should be taken to prevent interchange of such waters in the well.

To determine whether water of inferior quality is entering the well, a sample of ground water should be collected upon completion of the well. The quality of the natural ground water entering the well should be compared to that of adjacent ground waters. An expedient method of determining the relative quality of each is by comparison of the electrical conductivity. This test gives an indication of the concentration of total dissolved solids in the water. If the test for electrical conductance indicates the water from the well is inferior to the adjacent waters, more complete analysis of the well water may be necessary to determine whether remedial measures will be required to prevent entrance of poor quality water into the well.

Analysis for chloride ion concentration, per cent sodium, and boron, in addition to electrical conductivity, is generally adequate for interpretation as to the effect of the quality on most beneficial uses in Mendocino County. One pint of water should be sufficient for the purpose of this analysis. Analysis for other constituents such as iron may be desirable when conditions indicate that these constituents may cause problems.

Sealing Off Strata

It is sometimes necessary to seal off strata in a well. Most common reasons are entrance of poor quality water or entrance of excessive amount of sand from a particular stratum. There are two basic methods of sealing off strata. In the first method the casing opposite the stratum to be sealed is perforated. A packer, concrete plug, or other device is placed in the casing at the bottom of these perforations. Grout or neat cement is placed in the casing in the zone to be grouted by means of a dump bailer or grout pipe. A packer or other means of sealing the casing is placed above the perforations, and pressure is applied to force the neat cement or grout through the perforations into the zone to be sealed off. Pressure is maintained until the material has set. The packer and other material remaining in the hole are then drilled out. This method may be advantageous where the vertical distance to be sealed out is not great.

The second method of sealing a stratum involves placement of a liner pipe of smaller diameter than the original casing and sealing the annular space between the two casings. Usually the double casing is installed only in the portion to be sealed off. The annular space between the two casings is then filled with neat cement or cement grout; however, this method may not permit effective sealing of the annular space between the outside casing and the wall of the hole.

A combination of the foregoing methods is often used to insure that the stratum is effectively sealed; other methods have also been used with success. The choice of a particular method or combination of methods to be used depends largely upon physical conditions in the well.

To assure that the entire zone from which the poor quality water is entering the well is sealed, we believe the interval to be sealed should extend upward from at least 10 feet below the bottom of the zone to at least 10 feet above the top of the zone.

Grout, neat cement, or a substance with similar characteristics should be used as the sealing material. The United States Public Health Service (32) recommends that neat cement should be a mixture of cement and water in the proportion of one bag of cement (94 pounds) to five or six gallons of clean water. They state that cement grout should be composed of one bag of cement, an equal volume of sand, and five to six gallons of clean water. Whenever possible water content should be kept near the lower limit given. Hydrated lime to the extent of 10 per cent of the volume of cement may be added to make the grout mix more fluid and thereby facilitate placement by pumping equipment.

The American Water Works Association (1) states that one or two parts of sand to one part of cement and not more than 5 1/2 gallons of water per cubic foot of cement will provide suitable encasement material.

Twelve drillers replied to a question regarding proportions of cement, sand, and water used in cement grout. Two stated they did not use cement grout. Proportions of cement to sand used by the others varied from 1:2 to 1:5. Only one driller stated a specific proportion of water; he uses 6.5 gallons of water per sack of cement.

For purposes of sealing off strata neat cement is to be preferred over cement grout because of the possibility of separation of cement and sand during placement. It should be noted that any cementing material used in a sealing process should be placed by dump bailer, grout pipe, or other method which precludes free fall and separation of the material.

Sufficient grout should be placed to seal the annular space between the outer well casing and the wall of the drill hole and to seal any voids or openings which may absorb sealing material. The amount of cement required when sealing the annular space depends upon the formations being grouted. The Department of the Army (16) states that generally an allowance of from 25 to 100 per cent in excess of the calculated amount should be available. To this must be added a suitable allowance for absorption of grout material by crevices, fissures, and pores in the formations to be grouted.

We feel that the minimum amount of sealing material that should be applied to assure a satisfactory seal is at least 150 per cent of the volume inside the casing in the interval to be sealed. The amount in excess of that required to fill the interval to be sealed should be forced outside the casing into the outside annular space and into any voids which might absorb sealing material.

Pressure applied to force the sealing material into the zone to be sealed should be held until the material has set. The United States Public Health Service (32) states that grout will be set in 3 to 7 days. The American Water Works Association (1) indicates that 72 hours or more should be allowed for the grout to set before drilling out the grout plug.

J. E. Brantly (7) states that the period prior to initial hardening of cement must be sufficient to permit placement of the material before it ceases to be pumpable, and at the same time the period prior to initial hardening and final set should be short enough to prevent any undue lost time while waiting for the cement to set. With the use of present-day materials and processes the waiting time may be as short as 24 hours and seldom over 72 hours.

The majority of drillers contacted indicated that they use cement placed by various methods for the purpose of sealing-off strata. A few indicated that they use alternate methods such as watertight casing or clay.

Surface Features

Proper well drilling practices include details of surface construction as well as subsurface construction. A potential source of impairment to quality of ground water is leakage of surface or near-surface water down the outer annular space between the well casing and the wall of the drill hole. As indicated in previous sections of this report these surface waters are often highly mineralized or contaminated. Another potential source of impairment is the entrance of surface water, foreign material, insects, or animals through the top of the casing.

Surface Protection. Any annular space near the ground surface between the casing and the formation should be sealed to prevent surface or near-surface waters from entering this space and moving downward to ground water.

The United States Public Health Service (32) recommends that the annular space between the well hole and the outside well casing should be filled with not less than 1 1/2 inches of impervious cement grout to a depth of at least 10 feet and to such greater depths as may be required by the health officer. They further recommend that for gravel treated wells the gravel surface should be terminated not less than 10 feet below ground surface and that the remaining distance to land surface should be effectively sealed.

The American Water Works Association, in their specifications for deep wells (1), state that in every well the casing and seal must extend to such height and depth as will prevent contaminated water from entering the surface or from the soil and rock strata through breaks in the natural protective formations. In fractured rock formations considerable protection for the supply will be attained by casing and sealing the annular space to a depth of from 15 to 20 feet below the lowest pumping level.

For dug and bored wells, the Federal Housing Administration (17) states that if concrete is to be used for the watertight casing, where possible, the concrete should be poured against undisturbed earth and no outside form shall be used.

The Department of the Army (16) states that one place where surface pollution enters a well is around the outside of the casing or curbing. The space between the outside of the curbing or casing and the wall of the hole therefore must be sealed securely at the surface to prevent the downward percolation of undesirable water. This can be accomplished by thoroughly puddling the space around the casing with clay and sealing the upper part with concrete. The upper seal should be permanent watertight construction from a suitable elevation above the permanent grade at the well into a continuous impervious formation, or to a safe depth below the probable present or future maximum drawdown of the water level.

About half the drillers in Mendocino County replying to a question regarding techniques used to seal off surface waters recommended grouting or cementing the annular space outside the casing to various depths. The remainder recommended watertight casing and/or concrete seal at ground surface.

The space between the outside casing and the wall of the drill hole in gravel-packed wells should be sealed as in a regular drilled well; however, a means of adding gravel to the envelope should be provided. If a conductor pipe is used the seal should be between the conductor pipe and the wall of the drill hole. If a conductor pipe is not used the seal should be between the casing and the wall of the drill hole. In both cases a means of adding gravel to the gravel envelope should be provided. In the first case the gravel may be added between the casing and the conductor pipe. In the second case a gravel fill pipe may extend from above the seal downward through the seal to the envelope. Whatever method is used the opening at the top should have a watertight removable cover or cap.

The United States Public Health Service (32) recommends that the gravel surface terminate not less than 10 feet below the ground surface and that the annular space between the drilled hole and the well casing, above the gravel surface be filled with thoroughly compacted puddled clay, mortar, or cement grout.

Seven of the ten drillers in Mendocino County replying to a question regarding their method of sealing the outside annular space of a gravel-packed well stated they use cement grout. Of the remaining three answering the question one uses cement grout or native material, one uses 30 to 35 feet of rotary mud, and one does not seal the annular space.

As a protective measure against potential pollution or contamination of ground water supplies we believe that ground water conditions in Mendocino County indicate that there should be a watertight seal between the casing and the wall of the drill hole extending from ground surface to a depth of at least 15 feet in all wells.

The casing of drilled wells should rise a suitable distance above ground surface to allow the construction of an adequate concrete pedestal. The pump pedestal should be thick enough to be structurally sound, it should extend beyond the pump base in all directions, and it should be sloped away from the well for rapid drainage. The pedestal should rest on thoroughly compacted earth.

The United States Public Health Service (32) recommends that the casing extend at least 6 inches above the established ground surface at the well or the floor of the pump house. In addition they recommend that the cover, pump platform, or pump room floor should be made of reinforced watertight concrete sloped from the well casing to the outer edges of the slab and the slab at its outer edge should not be less than 4 inches thick. They also state that in the case of drilled wells equipped with hand-operated pumps, the concrete slab should extend not less than 2 feet from the well casing in all directions and that the cover of a dug well should be watertight and properly grouted in place. Its edges should extend at least 2 inches beyond the outer edge of the casing or curbing of the well.

The California State Department of Public Health (8) states that in cased wells, the casing should be intact a foot or so above ground and that a concrete platform around the well shedding away from the well is important.

Since dug wells are usually shallow special attention must be given to surface construction to insure that no undesirable material impairs the ground water supply. Casing should rise to an adequate height above ground level and should be covered with a watertight cover capable of withstanding any load which may be placed on it. The cover should have a definite slope away from the well. Any openings in the cover for column pipe or other equipment should be securely sealed.

The Department of the Army (16) states that for an open dug well a watertight cover, preferably of impervious concrete, may be used. Wood covers are subject to more or less rapid deterioration, and because of constant warping and shrinking they cannot be kept watertight easily. The casing should extend at least one foot above the general level of surrounding surface.

The California State Department of Public Health (8) states that the curb of dug wells should extend above the ground, the whole top cover should be made watertight, and there should be a concrete apron around the well shedding water a few feet away from it. This is to avoid pollution following down the side of the well.

Eleven of the sixteen drillers interviewed recommended that casing extend 12 inches or more above ground surface or above the pump platform. The remainder recommended that the casing extend 10 inches above the top of the pump platform.

Most of the drillers who install pump platforms recommended that the platforms be made of concrete or cement.

To facilitate disinfection and to permit measurement of depth to water an opening should be provided to allow access to the inside of the casing. An opening of at least two inches in diameter is recommended to permit easy entrance of disinfectant and measuring tape. The opening should be covered with a watertight cap when the opening is not being used.

A vent pipe is often used in large capacity wells to prevent formation of a vacuum in the casing due to evacuation of water from the well. The vent pipe should extend above the casing and terminate in a return bend. The opening into the pipe should be screened to prevent the entrance of foreign material into the well.

The United States Public Health Service (32) recommends that the air vent be constructed of metal tubing or pipe and connected so as to be watertight. The open end of the vent shall be screened and terminated in a downward direction through use of an elbow or equivalent means and the lower end of the outlet shall be not less than 12 inches above the top of the well casing, and in no case less than 18 inches above the floor of the pump room.

The California State Department of Public Health (7) states that openings into casing for air-pressure relief, for sounding, for introduction of gravel, or for other purposes necessary to operation of the well, may be permitted but must terminate above floor and high-water levels. These openings should be protected against such things as small animals, insects, flood water, drainage, or pump drippage by such things as caps, screens, or downturned "U" bends, as suitable to the given situation.

Five water well drillers in Mendocino County recommended use of well vents ranging from vents on all wells to vents on only certain types of wells. Three drillers felt that vents were not necessary. Three drillers made comments regarding sounding tubes; two recommended inclined pipes ranging from one to two inches in diameter, the third recommended sounding tubes on rotary wells but not on cable tool wells.

If the pump is not installed upon completion of the well a watertight seal shall be provided at the top of the casing to prevent entrance of surface water or foreign material into the well. The United States Public Health Service (32) states that in case the pump and drop pipe are not installed immediately after the casing is installed, the top of the casing should be provided with a water tight seal or overlapping cover at the top until the installation is completed and a permanent seal is provided.

Practices of sealing the top of open casing prior to pump installation vary greatly in Mendocino County.

Installation of the pump should be made so as to prevent surface water from entering the well through the top of the casing. If the pump is installed directly over the casing a watertight seal may be obtained by sealing the pump base to the platform by using a gasket or adequate sealing material providing the pump base is watertight. Other satisfactory methods include use of a sanitary well cap which seals the casing to the column pipe, or setting the pump so as to secure a watertight seal between the pump base and top of the casing.

If the pump is offset from the well a watertight seal should be provided between the casing and the pipe or pipes entering the well.

The Federal Housing Administration (17) and the United States Public Health Service (32) specify that the pump base shall be constructed so as to permit installation of a watertight seal between the casing and suction pipe.

The Department of the Army (16) states that in general most contamination enters the well at the surface through the well opening, hence it is important that the space between the casing and the pump pipe be sealed tightly by an approved sanitary well seal or a suitable bushing and packing gland.

The California State Department of Public Health (7) suggests that all pumps located over wells shall be mounted on the well casing, or a pump foundation, or a pump stand, so as to effectively seal the top of the well. Where the pump unit is not located over the well, the casing should terminate above floor level (unless a tightly sealed submersible pump is used) and a watertight seal shall be provided between the well casing and discharge pipe.

Most drillers in Mendocino County replying to questions regarding use of pump seals stated that in their opinion no seal is necessary.

Well Pit. The use of well pits should be avoided if possible. Pits provide a means for accumulation of contaminated surface or near-surface water and drainage is difficult.

The Federal Housing Administration (17) states that when possible the pump shall be so located and designed as to make the use of a pump pit unnecessary; however, if used the pit shall be provided with a 4 inch gravity drain to the ground surface. A pump pit shall not be used with a dug well and in no case shall the pump be located in a dug well.

The United States Public Health Service (32) recommends that pits shall be of watertight construction with walls extending at least 6 inches above the established ground surface at all points. Pits shall be provided with a watertight concrete floor sloping to a drain which discharges to the ground surface at a lower elevation than the pit and at least 30 feet from it; or if this is impossible, to a watertight concrete sump, in the pit, equipped with an automatic sump pump discharging to the ground surface at least 30 feet from the pit. Pits shall be provided with a concrete base for pumps so that such units shall set at least 12 inches above the floor of the pit. Pits shall be provided with a satisfactory housing or cover in all cases.

Most of the drillers interviewed in the county recommended against the use of well pits although well pits were sometimes used to protect the pump installation from freezing.

Pump House. A pump house should have adequate drainage to facilitate the removal of water from about the well. The United States Public Health Service (32) states that a floor drain with the inlet not less than 2 feet from the outer edge of the casing should be provided. A pipeline connected to the drain should ultimately discharge onto the ground surface or into an absorption pit located not less than 30 feet from the source.

Pump houses were noted at about 60 per cent of all the wells inspected in the county. Most of the houses were made of wood and in good condition. About 50 per cent had concrete floors; the remainder were wood or dirt. Floors in about half the pump houses drained toward the well. Generally responsibility for construction of pump houses lies with the owner and not the driller.

Well Disinfection

Ground water is subject to contamination from workmen, equipment, materials, or surface water which may be introduced into the well during construction. Although pumping may eventually remove such contamination the well should be disinfected to assure a water of good sanitary quality.

To obtain satisfactory disinfection, the amount of available chlorine should be at least 50 ppm for the volume of water in the well below the water table (1). A common rule for finding the amount of disinfectant required in ounces is to multiply the volume of the well below the water table, in gallons, by 0.7 and divide by the per cent available chlorine in the disinfectant. For example, if a well with a volume of 200 gallons below the water table is to be disinfected with a material containing 15 per cent available chlorine, the amount of such material required would be 9.3 ounces. This amount was obtained in the following manner:

$$\frac{0.7 \times 200 \text{ (gallons)}}{15 \text{ (per cent available chlorine)}} = 9.3 \text{ ounces of disinfectant.}$$

One of the most commonly used disinfectants is chlorinated lime, which contains approximately 25 per cent available chlorine. Three ounces of chlorinated lime are added for each 100 gallons of water in the casing.

To prepare the disinfectant for placement in the well chlorinated lime and water should be mixed in a ratio of not more than 5 ounces of chlorinated lime for each gallon of water. This is to assure that the chlorine in the disinfectant will completely dissolve in the water. The United States Public Health Service (32) recommends the following procedure for preparation of this solution. To the amount of chlorinated lime required, add small quantities of water slowly and stir until a smooth, watery paste free from lumps has been formed. Add the calculated amount of water to the paste, and stir thoroughly from 10 to 15 minutes. Then allow the solution to settle. The clearer liquid containing the chlorine should be used, and the inert material or lime that has settled to the bottom of the container discarded. The prepared solution is then poured into the well and the pump is started and stopped several times to agitate the mixture in the well column. The pump is then run until the odor of chlorine is detected in water discharging from the pump. The well is allowed to remain idle for approximately 24 hours. Water is then pumped to waste until the taste or odor of chlorine is no longer detectable.

The California State Department of Public Health (7) states that all new wells shall be properly disinfected or the water produced be of demonstrated satisfactory bacterial quality before the well is placed in service.

The United States Public Health Service (32) states that underground water supplies shall always be disinfected following new construction or repair work, to remove all traces of contamination. They deem this to have been satisfied when:

1) All new construction and repair work is disinfected with a chlorine solution containing not less than 50 parts per million of available chlorine; provided, that where minor repairs are made to existing ground water supplies and adequate treatment of the water is provided beyond the point where repairs are made, disinfection shall not be mandatory.

2) Not less than five parts per million of residual chlorine is present at the source and at other representative points which have been in contact with the chlorine solution for a period of at least three hours and preferably 10 hours or longer; provided, that in case of flowing springs and flowing wells this requirement shall not be mandatory.

3) The system is thoroughly pumped or otherwise thoroughly flushed to remove all traces of chlorine after disinfection.

4) The results of bacteriological examination of water samples collected after disinfection and flushing of newly developed ground water supplies show that all traces of contamination have been eliminated. Such tests shall be repeated at least once after the system is shown to be clean, to check on possible regrowths.

Of sixteen drillers interviewed regarding their methods of disinfecting wells, thirteen stated they use various compounds containing free chlorine. Their usual method is to pour a mixture of an unmeasured amount of chlorine into the well, surge the well, then let stand for a period of ten minutes to two hours before pumping the well clear of chlorine.

Pump Lubrication

The pump may furnish a means of impairment of ground water quality by permitting leakage of lubricants into the well. Foreign material which may render the water undesirable for domestic use may be introduced into the well during pump installation or maintenance.

The United States Public Health Service, in its "Sanitation Manual for Public Ground Water Supplies" (32), states that lubrication of pump bearings, situated in a well below the pump room floor, with oil, grease, or water other than of a safe sanitary quality may result in contamination of the water supply.

The California State Department of Public Health (8) states that one of the main points about sanitary well construction is choosing a pump that produces little drippage and keeping it in that condition.

Considerable amounts of oil were found on many of the pump installations in Mendocino County indicating a possible source of impairment to the quality of ground water by leakage of oil into the well. This condition appears to be due more to unsatisfactory maintenance than to improper pump installation.

Appraisal of Sanitary Quality of Ground Water

As a means of evaluating the adequacy of present well construction methods and site locations in Mendocino County, a total of 184 ground water samples were collected for bacteriological examination. Samples were collected from typical wells in each major valley area. Locations of wells investigated and sampled are shown on Plates 8 through 11. Results of the bacteriological examinations are shown in Table 4, Appendix A.

Bacteriological examinations of domestic water, by estimating bacterial density, is considered to be of significant value in appraising sanitary water quality. Quantitative estimation of the amount of coliform group of bacteria present in a particular sample is almost universally conceded to be the most significant because it affords the most nearly specific test for the probable presence of disease producing organisms. Although not pathogenic or disease producing in itself, the coliform group of bacteria is invariably found in large numbers in soil and in the feces of man and warm blooded animals. Since the densities of coliform bacteria in water serve merely as an indication of the possibility of contamination, their use should only supplement information obtained from a field survey of the well installation, appurtenances, and surroundings.

A book entitled "Standard Methods for the Examination of Water, Sewage and Industrial Wastes", prepared and published jointly by the American Public Health Association, the American Water Works Association, and the Federation of Sewage and Industrial Wastes Associations, presents adopted procedures for conducting bacteriological examinations and related activities. These procedures indicate that all samples should be prepared and incubated as soon as possible after collection. This is necessary to insure an accurate evaluation of bacteriological quality at the time of sample collection. Coliform organisms may multiply or diminish in transit if special precautions are not observed. For this reason the mobile laboratory of the Department of Water Resources was stationed in Willits during the sampling period. Samples were collected in outlying valleys and promptly transported to Willits in iced containers. Sampling schedules were so arranged that a maximum of four hours elapsed between time of sample collection and examination at the laboratory.

In evaluating the suitability of a domestic water supply from a sanitary standpoint, any results indicating positive coliform densities would be sufficient to cause the water supply to be regarded with suspicion. This is especially true when coupled with poor well construction, improper site location, or any other physical indication of a possible source of contamination. Frequent and lengthy sampling should be undertaken before a truly reliable appraisal can be made of the sanitary quality of water from a particular source. For the purpose of this study, however, sampling was limited to the collection of one bacteriological sample from each well. Results of coliform determinations were divided into the following arbitrary levels or groups for appraisal. The results are expressed as the "most probable number" (MPN) of coliform bacteria per 100 milliliters (ml) of sample.

STANDARDS FOR EVALUATING
BACTERIOLOGICAL DETERMINATIONS

MPN Coliform bacteria/100 ml	Arbitrary level of contamination
Less than 2.2	None
2.2 to 38	Slight
38 to 240	Moderate
240 or more	Excessive

Groups of wells were selected for sampling in each major valley area according to the following classifications:

(1) Wells indicating the better location and construction practices were classified as "good".

(2) Wells whose construction were typical for each area were classified as "average".

(3) Wells so poorly constructed as to be readily susceptible to contamination were classified as "defective".

The following unsatisfactory conditions were considered in classifying the construction of each well. Any of these conditions were assumed to be sufficient reason for suspecting contamination of the ground water supplies, the degree was dependent upon specific conditions found at each well.

(1) Septic tank, cesspool, or pit privy within 50 feet of well.

(2) Casing or joints not watertight from ground surface to the water table or a minimum depth of 15 feet.

(3) Seal between platform and casing not watertight.

(4) Seal between casing and pump not watertight.

(5) General surroundings in an unsanitary condition.

(6) Surface drainage toward well.

(7) Close proximity to barnyard or other possible sources of contamination.

Presented in Table 8 is a summary of the results of bacteriological examinations of water samples from wells in each of the major valley areas in Mendocino County and a comparison of these results with the foregoing classifications of well construction.

COMPARISON OF RESULTS OF BACTERIOLOGICAL EXAMINATIONS WITH
CLASSIFICATION OF WELL CONSTRUCTION
MENDOCINO COUNTY

Area	Classification	Number of wells with MPN - coliform bacteria/100 ml: Less than 2.2	2.2 to 38	38 to 240	240 or more	Totals
Anderson Valley	Good	5	0	0	1	6
	Average	10	1	0	1	12
	Defective	3	1	1	0	5
Subtotals		18	2	1	2	23
Sanel Valley	Good	5	0	0	1	6
	Average	1	2	0	2	5
	Defective	1	2	1	0	4
Subtotals		7	4	1	3	15
Laytonville Valley	Good	0	1	1	0	2
	Average	3	2	1	2	8
	Defective	1	2	1	3	7
Subtotals		4	5	3	5	17
Little Lake Valley	Good	2	0	0	0	2
	Average	2	4	1	4	11
	Defective	0	1	0	6	7
Subtotals		4	5	1	10	20
Potter Valley	Good	0	1	1	0	2
	Average	1	2	0	3	6
	Defective	1	4	1	2	8
Subtotals		2	7	2	5	16
Round Valley	Good	5	0	0	0	5
	Average	8	0	2	1	11
	Defective	7	0	0	0	7
Subtotals		20	0	2	1	23
Ukiah Valley	Good	4	2	0	2	8
	Average	5	2	1	7	15
	Defective	2	2	1	4	9
Subtotals		11	6	2	13	32
Fort Bragg Terrace	Good	8	3	1	0	12
	Average	5	5	0	1	11
	Defective	2	2	0	0	4
Subtotals		15	10	1	1	27
Point Arena Terrace	Good	3	0	0	0	3
	Average	5	0	0	1	6
	Defective	0	2	0	0	2
Subtotals		8	2	0	1	11
Summary for County	Good	32	7	3	4	46
	Average	40	18	5	22	85
	Defective	17	16	5	15	53
TOTALS		89	41	13	41	184

Table 9 shows a comparison of the results of the bacteriological examinations with the number of unsatisfactory environmental or construction conditions noted at wells included in the field survey.

TABLE 9

COMPARISON OF RESULTS OF BACTERIOLOGICAL EXAMINATIONS WITH FIELD SURVEY OF WELLS MENDOCINO COUNTY

Number of unsatisfactory conditions noted	Number of wells with MPN - Coliform bacteria/100 ml				Totals
	Less than 2.2	2.2 to 38	38 to 240	240 or more	
None	71	21	2	2	96
One	6	10	1	8	25
Two	6	4	3	7	20
Three or more	6	6	7	24	43

The above table indicates that:

(1) Results of bacteriological examinations indicated no contamination in about 74 per cent of the wells where no unsatisfactory conditions were noted and slight contamination in about 22 per cent. Only about four per cent showed moderate or excessive contamination.

(2) Moderate or excessive contamination was indicated in about 36 per cent of the wells with one unsatisfactory condition noted, in about 50 per cent of the wells with two unsatisfactory conditions noted, and in about 72 per cent of the wells with three or more unsatisfactory conditions noted.

The limited bacteriological data and the relationship between these data and well construction, indicate that there is a need for correction of certain water well construction practices in Mendocino County.

Sealing of Abandoned Wells

A well should be abandoned and properly sealed if the ground water supply is no longer needed or if the well cannot be used due to structural failure or to mineralized water which cannot be sealed off. Essentially, sealing an abandoned well involves replacing the geologic formations which existed before the well was drilled with materials at least as impervious as the original formations. An impervious plug should be placed in the upper portion of the well to exclude surface water. The top of the plug should be set at sufficient depth below ground surface to prevent damage to any equipment used in working the land.

Where necessary, casing should be either pulled or deformed so that the annular space between the casing and the hole can be filled with sealing material and thus prevent the annular space from acting as a channel for vertical movement of water.

If the well penetrates water-bearing strata containing water of poor quality or if mineralized water originates from the bottom of the well, an impervious plug should be placed in such a manner as to prevent movement of these waters into usable water-bearing formations. If the well penetrates a confined aquifer which is under pressure, the confining formation should be sealed to prevent movement of water between formations or loss of water to ground surface.

The American Water Works Association (1) states that removal of liner pipe from some wells may be necessary to assure placement of an effective seal. If liners or casings opposite water-bearing zones cannot be readily removed, they should be split with a casing ripper to assure the proper sealing of water-bearing zones with sealing material. At least the upper portion of the casing should be removed to prevent surface water from entering the water-bearing strata by following down the casing. This operation is not always essential if the annular space around the outside of the casing was cemented when the well was drilled.

In addition, the American Water Works Association states that the sealing of abandoned wells that have a large movement of water between aquifers or to the surface requires special attention. Frequently the movement of water may be sufficient to make sealing by gravity placement of concrete, cement grout, neat cement, clay or sand impractical. In such wells, large stone aggregate (not more than one-third of the diameter of the hole), lead wool, steel shavings, a well packer, or a wood or cast-lead plug or bridge may serve to sufficiently restrict the flow to permit the gravity placement of sealing material above the formation producing the flow. It is recommended that pressure cementing with a mixture of cement and the minimum quantity of water that will permit handling be employed. The use of pressure mudding instead of this process is sometimes permissible.

The United States Public Health Service (32) recommends that drilled or cased wells should be filled completely with neat cement, cement grout, concrete, or clean puddled clay, and dug wells be filled completely with puddled clay or its equal after as much as possible of the curbing is removed.

To prevent movement of surface or near-surface water down the annular space between the casing and wall of the drill hole, we believe an impervious plug of neat cement, cement grout, or puddled clay at least 10 feet in length should be placed in the upper portion of the well. The bottom of the plug should be at a depth not greater than 25 feet below ground surface. Prior to placement of the plug the casing should be removed from the bottom of the interval to be plugged to ground surface, and at least to a depth of 15 feet, unless the annular space between the casing and the wall of the drill hole was sealed with impervious material prior to abandonment. Native material should be placed from top of the plug to ground surface.

When a confining formation above a pressure aquifer is to be sealed in a nongravel-packed well, the casing should be ripped or perforated in the interval from the bottom to the top of the stratum to be sealed and neat cement, cement grout, or puddled clay should be forced under pressure through the perforations into the annular space outside the casing. To assure that this annular space is sealed, the volume of sealing material to be applied should be at least 150 per cent of the volume inside the casing in the interval to be sealed. The sealing material inside the casing should extend from the bottom to the top of the perforated interval after the pressure is removed. Other than the aforementioned plug in the upper portion of the well the remaining portion of the well above the impervious plug should be filled with neat cement, cement grout, puddled clay, or native material which is free from any organic material which might cause pollution or contamination of ground water.

Sealing of gravel-packed wells, particularly in confined aquifers, may require special attention. If a confining formation in a gravel-packed well is to be sealed it is essential that sealing material (neat cement, cement grout, or puddled clay) be placed in the space between the well casing and the confining formation, as well as inside the casing in the vertical interval to be sealed.

Three possible procedures for sealing confining formations in gravel-packed wells are as follows:

(1) Perforate the casing in the vertical interval to be sealed. Force sealing material through the perforations and into the gravel envelope so that the voids in the envelope are filled throughout the thickness of the envelope in the vertical interval to be sealed. Sealing material should also fill the perforated interval inside the casing.

(2) Force sealing material through the gravel envelope from the bottom to the top of the well and place sealing material inside the casing from the bottom of the well to a point above the top of the formation to be sealed.

(3) Remove casing and gravel to a depth below the formation to be sealed. Place sealing material in the vertical interval to be sealed.

In developing a gravel-packed well, fine material from the formation is drawn into the voids in the gravel envelope. The amount of fines retained in the voids of the gravel decreases from the formation toward the casing due to increase in velocity of water through the gravels nearer the casing and the resultant removal of the fines near the casing. When sealing material is forced into the gravels it may tend to flow in the direction of least resistance through the portion of the gravel near the casing where the void space is greatest thus preventing the sealing material from extending laterally to the formation. For these reasons the third method is preferable.

Tolman (21) states that when gravel-envelope wells are abandoned owing to contamination or in cases where contamination is a possibility, the wells should be completely sealed from top to bottom by cement introduced under pressure and in sufficient quantity to fill the gravel envelope as well as the interior of the casing.

The American Water Works Association (1) states that in gravel-packed, gravel-envelope, or other wells in which coarse material has been added around the inner casing to within 20 to 30 feet of the surface sealing outside the casing is very important. Sometimes this sealing may require removal of the gravel or perforations of the casing.

Eight of the sixteen drillers interviewed who operated in Mendocino County stated they construct gravel-packed wells, and although no recommendations were made on methods of abandoning such wells they did make recommendations for sealing-off strata in gravel-packed wells. Two recommended cement liners, three recommended cementing the strata to be sealed, one recommended grout from bottom to the first strata to be sealed or the first non-porous strata to ground surface, and one recommended clay and cement and a cement cap. One driller stated that he did not usually seal-off strata in gravel-packed wells due to the prohibitive cost.

The method chosen for sealing abandoned gravel-packed wells must assure that no degraded or contaminated water enters usable aquifers through the abandoned wells. We believe the most reliable method is to remove the casing and gravel to a depth below the formation to be sealed, and to place cement grout, neat cement, or puddled clay in the vertical interval of the confining formation in addition to placement of the impervious plug near the upper portion of the well as previously discussed.

Of eleven drillers making recommendations regarding material used for permanently abandoning wells in Mendocino County, five recommended cement grout, five recommended native material, and one recommended gravel or rock. Five drillers stated they had never permanently sealed an abandoned well.

CHAPTER IV. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

(1) Throughout Mendocino County there are numerous small alluvial areas capable of storing, transmitting, and yielding economically significant quantities of ground water. Ground water in these alluvial areas is usually stored in interconnected lenses of sand and gravel; few of the areas having continuous definable aquifers. Pressure aquifers of limited areal extent exist in the major valleys. Known aquifers vary greatly in thickness. Our survey indicates that the majority of wells found in the county are shallow; only about five per cent reach depths over 200 feet. Depths to ground water are generally shallow thus presenting a threat to ground water quality resulting from the limited depth of unsaturated soils available for natural filtration processes.

Silts and clays are extensive throughout the areas studied and greatly limit the storage capacity and impede the movement of ground water. Yields to wells are generally small but are usually sufficient to satisfy domestic and limited agricultural requirements.

(2) Mineral quality of ground water is generally excellent with the exception of universally high iron concentrations. There are numerous isolated areas where ground water quality has been degraded by highly mineralized juvenile or deep-seated water rising along joints and fractures in the underlying bedrock. These sources of degradation have not to date affected appreciable areas, principally because draft on ground water has not been large. However, where such degraded water is

found special methods of water well construction and sealing of abandoned wells are necessary to prevent the movement of these degraded waters into better quality ground water.

(3) The survey of present well construction practices combined with results of bacterial examinations indicate the need for correction of certain prevalent water well construction practices found in Mendocino County.

(4) Interviews with water well drillers operating in Mendocino County reveal a wide divergence in present construction practices and also in their opinions concerning good construction materials and practices. However, recommendations of the drillers show that they are aware of the need for adequate water well construction and that they have sufficient knowledge of construction methods to solve any well drilling problems encountered.

(5) With the exception of established water well drillers, there is a general lack of knowledge of the principles of proper water well construction and sealing of abandoned wells necessary to protect the quality of ground water from degradation throughout Mendocino County.

(6) General standards of water well construction and sealing of abandoned wells are necessary in the alluvial areas of Mendocino County for the following reasons:

(a) Shallow ground water table conditions exist throughout extensive areas.

(b) Septic tanks, seepage pits, and cesspools are generally used for disposal of wastes.

(c) Present methods and techniques of water well construction do not appear adequate.

(7) Additional standards of water well construction and sealing are necessary in portions of Sanel, Laytonville, Potter, and Round Valleys for the following reasons:

(a) Sanel Valley - to prevent the upward migration of highly mineralized waters known to exist at depths greater than 500 feet in that portion of Sanel Valley delineated on Plate 8.

(b) Laytonville Valley - to prevent the commingling of poor quality water in the upper zone with good quality water in the lower zone. The lower zone is overlain by a confining clay cap. Water under the confining clay cap is under pressure and artesian conditions are prevalent. The area involved is shown on Plate 9.

(c) Potter and Round Valleys- to prevent interchange of water between the pressure and overlying free-water aquifers which exist in each of the valleys, should either aquifer become degraded in the future. Artesian conditions are prevalent in these pressure areas. The areas involved are delineated on Plate 9.

Recommended Standards of Water Well Construction and Sealing

The following water well construction and sealing standards are deemed necessary to protect the quality of ground water resources of Mendocino County from impairment due to improperly constructed, defective, or abandoned wells. The Department of Water Resources recommends that they be adopted to govern the construction and sealing of water wells in Mendocino County.

General standards applicable to all of Mendocino County are presented in two sections: (1) water well construction and (2) sealing of abandoned wells. Additional standards considered necessary for Sanel, Laytonville, Potter and Round Valleys are presented following the general standards.

General Water Well Construction Standards

Well Location

Well sites shall be located on topographically high ground if possible. The site selected shall not be subject to normal flooding and shall be protected from surface or subsurface drainage from any source capable of impairing the quality of the ground water supply. The well site shall be located a minimum distance of 50 feet from septic tanks, cesspools, seepage pits, leaching lines, sewer lines, privies, garbage dumps, barnyards, or other possible sources of water quality impairment. Greater distances should be provided where possible.

Casing

The following recommended standards pertain to casing used for permanent installation in water wells.

Material. Casing Material shall be of sufficient strength, toughness, and thickness to resist all forces and stresses imposed during and after installation, and shall be capable of being joined with watertight joints. The material shall be impervious where required. No damaged or defective material shall be used.

Corrosion resistant material shall be used in areas where water is known or suspected of being corrosive.

Minimum thickness of metal casing shall correspond to those shown in the following tables.

MINIMUM THICKNESS FOR METAL
WATER WELL CASING FOR DRILLED WELLS
SINGLE CASING

Depth of casing in feet	Diameter in inches										
	6	8	10	12	14	16	18	20	22	24	30
	Thickness*										
0 - 100	12	12	12	10	10	8	8	8	8	8	3/16
100 - 200	12	12	10	8	8	8	3/16	3/16	3/16	3/16	1/4
200 - 300	10	10	8	8	8	3/16	3/16	3/16	1/4	1/4	1/4
300 - 400	10	8	8	3/16	3/16	3/16	1/4	1/4	1/4	1/4	5/16
400 - 600	10	8	3/16	3/16	3/16	1/4	1/4	1/4	5/16	5/16	5/16
600 - 800	3/16	3/16	3/16	3/16	1/4	1/4	1/4	5/16	5/16	3/8	3/8
over- 800	3/16	3/16	3/16	1/4	1/4	1/4	5/16	5/16	3/8	3/8	7/16

*Values above diagonal are U. S. standard gage
Values below diagonal are thickness in inches

MINIMUM THICKNESS FOR METAL
WATER WELL CASING FOR DRILLED WELLS
DOUBLE CASING
(CALIFORNIA STOVEPIPE)

Depth of casing in feet	Diameter in inches								
	10	12	14	16	18	20	22	24	30
	Thickness*								
0 - 100	12	12	12	12	10	10	10	10	8
100 - 200	12	12	12	10	10	10	10	8	8
200 - 300	12	12	10	10	10	10	8	8	8
300 - 400	12	12	10	10	10	8	8	8	8
400 - 600	10	10	10	10	8	8	8	8	8
600 - 800	10	10	10	8	8	8	6	6	6
over- 800	10	8	8	8	6	6	6	6	6

*Values are U. S. standard gage

Concrete casing poured-in-place or precast shall be adequately reinforced with steel and shall be free from voids, blemishes, or other defects which would impair its strength or watertightness.

Wood casing or cribbing shall not be used under any circumstances. Bricks and stone casing shall not be used except where watertight casing is not required.

Placement. Permanent casing shall be placed in all wells to a safe depth below ground surface which will prevent entrance of undesirable water and foreign material. All casing shall be inserted or placed with sufficient care to avoid damage to casing sections and joints. Placement shall be in such a manner as to leave all joints in a watertight condition, where such joints are required. Any damaged section shall be replaced and not used for permanent water well casing.

Care shall be exercised in placement of precast concrete casing to insure that the casing will not be chipped, cracked, or broken in such a manner as to impair its use as water well casing. Any section so damaged shall be replaced and not used for water well casing.

Care shall be exercised in placement of poured-in-place concrete to insure no honey combing, air spaces, or separation of materials. Concrete shall not be allowed excessive free fall. A tremie, drop pipe, dump bailer or other suitable arrangement shall be used to pour the concrete.

Casing shall be seated in a suitable formation or foundation when necessary to prevent rupture of the casing due to settlement. All concrete casing shall rest upon an adequate foundation of footing.

Diameter Reduction. When the casing diameter of a drilled well is reduced the two casing shall be overlapped at least eight feet. The annular space between the overlapped casings shall be sealed with concrete, cement grout, neat cement, or a permanent packer to make the joint watertight.

Reduction in diameter of a dug well is not permissible. Casing diameter shall remain constant throughout the depth of the well.

Joints. All wells shall extend to a minimum depth of 15 feet below natural ground surface and shall be lined with permanent casing joined in a watertight manner to a depth of at least 15 feet. Joints on all permanent casing in drilled wells shall be made watertight to the first impervious stratum, if one exists above the water-bearing stratum.

If such an impervious stratum does not exist the casing shall be made watertight to the lowest expected water table. In all drilled wells the casing shall be watertight to a depth of at least 15 feet below natural ground surface and to greater depths if necessary to exclude surface water and undesirable ground water. These standards shall pertain to single casing and to double casing fabricated by the California stovepipe method.

Joints shall be made watertight by one of the following methods:

(1) Butt welding

(2) Collar welding

(3) Threaded collars

If butt or collar welding is used, it shall extend completely around the circumference of the casing and shall be solid and free from blow holes.

Welded and threaded collars shall be equally as strong, durable and impervious as the casing.

In dug wells, lengths of precast concrete casing shall be securely joined by watertight mortar joints or by other watertight sealing devices. Ends of sections to be joined shall be thoroughly cleaned. Sufficient mortar shall be used to insure that each end of the sections to be joined will be bedded in mortar.

Construction joints of poured-in-place concrete casing shall be cleaned and roughened before continuing the pour. Such joints shall be watertight. No construction joint shall be permitted within 15 feet of ground surface.

Perforations. In areas where there is free ground water the minimum depth to perforations shall be several feet below the lowest expected water table and below the lowest sewage disposal facilities or appurtenances in the area. In areas where there is confined ground water the special standards specified in "Supplemental Water Well Construction and Sealing Standards for Sanel, Laytonville, Potter, and Round Valleys" shall apply. In no case shall the perforations be less than 15 feet below ground surface.

Perforations in steel casings shall be made by one of the following methods provided that the method used shall not unduly weaken, tear, deform, or otherwise damage the casing in such a manner as to impair its strength or effectiveness as water well casing.

(1) Factory

Chiselled

Milled

Punched

(2) Acetylene torch

(3) Cut-in-place

No perforated concrete casing shall be employed other than standard sections made for this purpose. However, mortared building blocks may be used.

Ground Water Sampling

A sample of water, not less than one pint, shall be obtained from any well upon completion of construction or repair of the well. The water remaining in the hole after completion of the well shall be completely flushed out of the hole prior to obtaining the sample to insure that the sample is representative of the natural ground water. The water shall be analyzed by a laboratory licensed in the State of California. Electrical conductivity of such sample shall be determined and reported by the owner to the agency responsible for enforcement of the well construction standards.

Where electrical conductivity is greater than 500 micromhos at 25° Centigrade, the water shall then be analyzed for chloride, boron, and per cent sodium. However, if the well is located in an area known to produce water with high boron concentration, or when high boron concentration may be expected, the sample shall be analyzed for boron although the electrical conductivity may be less than 500 micromhos. Per cent sodium shall be determined by dividing the sodium concentration by the sum of the concentrations of calcium, magnesium, sodium, and potassium (all expressed in equivalents per million) and multiplying by 100.

If the results of the analysis indicate values in excess of those shown in the following tabulation, the designated authorities shall determine if such water is a threat to quality of adjacent ground waters due to inadequate well construction. Should such a threat exist, the well shall be repaired or rebuilt in a manner that will eliminate the possibility of impairment. In the event that the well cannot be repaired to eliminate such threat of impairment, it shall be abandoned and properly sealed.

Constituent or property	Limiting values*
EC x 10^6 at 25° C.	3,000
Boron in ppm	2.0
Sodium in per cent of base constituents	70
Chloride ion concentration in ppm	350

Sealing Off Strata

When it is necessary to seal off strata from which poor quality water is entering a drilled well, the following procedure shall be used.

*See "Qualitative Classification of Irrigation Waters", Chapter II.

If the poor quality water is entering through the bottom of the well, the well casing, prior to sealing, shall be thoroughly perforated or ripped from the bottom of the well to a height which is at least 10 feet above the stratum from which the poor quality water is entering the well. If the poor quality water is entering through an intermediate stratum, the well casing, prior to sealing, shall be thoroughly perforated opposite the stratum from a point at least 10 feet below the bottom of the stratum to a point at least 10 feet above the top of the stratum.

After ripping or perforating the casing sufficient grout or neat cement shall be applied to occupy a volume of at least 150 per cent of the inside of the casing in the perforated interval to be sealed. The sealing material shall be placed by dump bailer, tremie, grout pipe, or other method which will not allow free fall and separation of the material. Sealing material in excess of that required to fill the casing in the perforated interval shall be forced through the perforations under pressure.

Where a seal is placed at the bottom of the well, sufficient time should be allowed for setting of the grout to prevent displacement of the sealing material when pumping operations are begun. Where an intermediate zone is sealed, pressure shall be maintained for a sufficient period to allow the grout or neat cement to set sufficiently to permit drilling without rupturing or displacing the seal outside the casing. The time of set shall be at least 24 hours and preferably 72 hours, depending upon the admixtures used.

Neat cement for use in sealing operations shall be composed of a mixture of cement and water in the proportion of one bag of cement (one cubic foot) to 5 or 6 gallons of clean water. Cement grout shall be composed of not more than two parts sand to one part cement to 5 or 6 gallons of clean water per bag of cement.

To facilitate placement or setting of grout or neat cement, commercial additives may be used provided they do not exceed 10 per cent of the volume of cement.

If poor quality water is found in a dug well, the well shall be abandoned and properly sealed.

Other methods of sealing off strata may be used upon approval of the enforcing agency.

Surface Protection

The annular space between the casing and the wall of the drill hole shall be sealed with cement grout, neat cement, or puddled clay from ground surface to a depth which will exclude surface water or undesirable ground water. This depth shall be at least 15 feet in all wells. The seal shall have a minimum thickness of 1 1/2 inches.

The sealing material shall be applied continuously in one operation beginning at the bottom of the interval to be sealed. If pressure grouting methods from within the casing are used, grout return to the surface shall be required. If grout is applied from outside the casing it shall be placed by a grouting pipe extending to the bottom of the interval to be grouted. The pipe shall remain submerged in grout during the entire time that grout is being placed. Variation of the above methods may be used at the discretion of the enforcing agency.

In gravel-packed wells the artificial gravel packing shall not be placed within 15 feet of the ground surface except when a conductor casing is used. If a conductor casing is not used, cement grout or neat cement shall be used to fill completely the annular space from ground surface to a depth of at least 15 feet. A gravel-fill pipe shall extend from above the pump pedestal, through the seal in the annular space, to a depth below the top of the gravel envelope. The pipe shall be adequately sealed with a watertight screw cap. If the conductor pipe is used, the gravel may terminate at ground surface; however, the annular space outside the conductor pipe shall be sealed to a depth of at least 15 feet. The opening at the top of the space between the inner and outer casing shall be sealed to prevent entrance of surface water. A gravel-fill pipe shall extend from above the pump pedestal, through the seal between the two casings, and into the gravel envelope. The pipe shall be adequately sealed with a watertight screw cap.

When the pump is to be placed over the casing of a drilled well, a concrete pedestal shall be poured directly against the casing. The pedestal shall rest on thoroughly compacted earth, with the top of the pedestal above ground surface. The pedestal shall be at least four inches thick at its outer edges, extend beyond the pump base, and slope away from the casing in all directions. The well casing shall extend at least one inch above the top of the pedestal.

All dug wells shall be protected by a cover. This cover shall be made of reinforced watertight concrete at least four inches thick at its outer edge. The upper surface of the cover shall be sloped away from the column pipe or pump column in all directions and shall extend beyond the outer edge of the curbing. The cover shall be sealed watertight to the curbing with rubber gaskets, cement mortar, mastic or other suitable material. All openings in the cover shall be adequately protected to prevent entrance of water or foreign material into the well.

A sounding tube at least two inches in diameter shall be installed in drilled wells through the pump pedestal and into the casing.

One end of the tube shall be welded watertight flush with the inside of the casing. The other end of the tube shall be equipped with a watertight screw cap. If an air relief vent pipe is provided, it shall terminate in a downward direction at least 18 inches above ground surface. The end of this vent pipe shall be screened.

A sounding tube in a dug well shall extend through the cover into the well. This tube shall be equipped with a watertight screw cap.

If the pump is not installed immediately upon completion of the well, a watertight seal shall be provided at the top of the casing.

The pump shall be installed so as to prevent surface water from entering the well. A watertight seal shall be provided between the casing and column pipe, the pump base and casing, or the pump base and pump pedestal. All holes in the pump base which open into the well shall be made watertight.

In dug wells a watertight seal shall be provided between the cover and column pipe or other pipes entering the well.

If the pump is offset, a packer or seal shall be provided to make a watertight seal between the column pipe or other pipes and casing or cover, in drilled or dug wells. The top of the seal shall be so shaped to prevent collection and retention of surface water or other foreign matter.

<u>Well Pit</u>

Well pits shall be avoided when possible. If a well pit is necessary, the walls and floor of the pit shall be made of watertight concrete construction. The floor shall slope away from the well casing to a drain or sump. A positive means of removal of drainage from the pit shall be provided. The drainage shall be discharged to the ground surface at least

30 feet from the pit. The well casing shall extend at least 12 inches above the floor of the pit. A well pit shall not be used in conjunction with a dug well.

Pump House

If a pump house is provided, it shall be equipped with a concrete floor sloped away from the well casing.

A drain shall be provided which will discharge outside the pump house. Where there is no natural slope from the pump house the drain shall discharge at least 30 feet from the well. Adequate ventilation shall be provided.

Well Disinfection

All wells to be used to supply water for domestic purposes or wells from which water may be obtained for drinking shall be adequately disinfected prior to use, but after installation of the pump unless otherwise specified by the enforcement agency.

Any available compound containing free chlorine may be used. The amount of available chlorine should not be less than 50 ppm for the volume of water in the well. After the disinfectant has been placed in the well, the pump shall be started and stopped several times to thoroughly mix the disinfectant with the water in the well. The pump shall then be stopped and shall not be operated for a period of 24 hours. Water shall then be pumped to waste until the taste or odor of chlorine is no longer detectable.

Pump Lubrication

Pumps installed over the casing of all wells shall be so designed and maintained that lubricants will not drip or discharge into the well.

General Water Well Sealing Standards

For purposes of these standards, a water well should be abandoned and sealed when:

(1) The well is not intended to be used in the future for production of ground water,

(2) the well has not been used to produce ground water for a period of five years, or

(3) water from the well, as determined by the designated authority, is causing or will cause damage to surface or ground waters of the area, and reasonable efforts to repair the well have been unsuccessful.

The following standards shall apply to all abandoned wells in Mendocino County. However, additional standards shall apply to wells located in problem areas as specified in "Supplemental Water Well Construction and Sealing Standards for Sanel, Laytonville, Potter, and Round Valleys".

The well shall be inspected prior to being sealed to determine whether the well is free from obstructions which would prevent adequate sealing. Where necessary the well shall be redrilled or cleaned out as near as possible to the original depth. As much of the casing shall be removed as possible or practicable.

An impervious plug of neat cement, cement grout, or puddled clay at least 10 feet in length shall be placed in the upper portion of the well. The bottom of the plug shall be at a depth not greater than 25 feet below ground surface. Prior to placement of the plug the casing shall be removed from the bottom of the interval to be plugged to ground surface and at least to a depth of 15 feet, unless the annular space between the casing and the wall of the drill hole was sealed with impervious material prior to abandonment. Native material shall be placed from top of the plug to ground surface.

The remainder of the well shall be filled with neat cement, cement grout, puddled clay, or native material which is free from any organic material.

Supplemental Water Well Construction and Sealing Standards for Sanel, Laytonville, Potter, and Round Valleys

Sanel Valley

In the area in Sanel Valley designated on Plate 8 as "Areas Requiring Special Water Well Construction and Sealing Standards", the following additional standards are deemed necessary to protect quality of the ground water overlying the zone of extremely poor quality water known to exist under pressure at depths greater than approximately 500 feet.

(1) No new well shall be drilled into the underlying zone of poor quality if said well is to be perforated in any usable aquifer.

(2) Any existing well which penetrates the zone containing water of poor quality shall not be perforated in upper zones containing water of good quality unless the interval from the bottom of the well to the top of the saline zone is sealed as directed under the section "Sealing Off Strata".

(3) Any existing well presently perforated in zones of both fresh and saline water shall be sealed so as to segregate and exclude the latter from the fresh water zone or zones.

(4) When an existing nongravel-packed well which penetrates the confined zone of poor quality water is to be abandoned, that portion of the casing from the bottom to the top of the confining material above the pressure aquifer shall be pulled or effectively ripped or perforated. The space from the bottom to the top of the confining material shall be

filled with cement grout, neat cement, or puddled clay. Sufficient material shall be placed to occupy at least 150 per cent of the volume inside the casing in the interval to be sealed. The excess sealing material shall be forced into the confining member so that sealing material inside the casing occupies only the vertical interval to be sealed. If the annular space between the casing and the confining formation was sealed with cement grout or neat cement when the well was drilled, this operation may not be necessary. The remainder of the hole shall be sealed as specified in "General Water Well Sealing Standards."

If a gravel-packed well is to be abandoned, and the gravel envelope extends through a confining formation, this formation shall be sealed by a method which will assure no interchange of water between zones of good quality water and saline water. This may be accomplished by removing the casing and gravel to a depth below the confining formation and placing sealing material in the vertical interval of the formation. The remainder of the well shall be sealed in accordance with "General Water Well Sealing Standards".

Laytonville Valley

In that area in Laytonville Valley designated on Plate 9 as "Areas Requiring Special Water Well Construction and Sealing Standards", the following standards are deemed necessary to protect the water quality in the lower zone:

(1) In order to prevent commingling of the upper poor quality water with the underlying good quality water in the pressure aquifer, no water shall be perforated in both the upper and lower zone.

(2) The annular space between the wall of the drill hole and casing of wells penetrating the pressure aquifer shall be sealed from the

bottom to the top of the confining material above the aquifer with cement grout, neat cement, or puddled clay. The sealing material shall be placed by forcing it upward from the bottom of the annular space to be sealed.

(3) All wells drilled into the artesian portion of the pressure aquifer shall be equipped with a suitable control device to prevent waste of water from artesian wells as specified in Sections 300-311 of the Water Code.

(4) When a well penetrating the pressure aquifer is abandoned, the confining material above the aquifer shall be sealed as described in item (4) for Sanel Valley.

Potter and Round Valleys

In those areas in Potter and Round Valleys designated on Plate 9 as "Areas Requiring Special Water Well Construction and Sealing Standards", the following standards are deemed necessary to prevent waste of water from artesian wells and to protect the quality of ground water:

(1) Wells shall be perforated in both the pressure zone and the overlying free-water zone only when absolutely necessary to obtain the required yields. If in the future, water from either aquifer endangers quality in the other, the zone from which the poor quality water is entering the well shall be sealed as directed in "Sealing Off Strata".

(2) Additional special standards for Potter and Round Valleys are identical to those set forth in Items 2, 3, and 4 for Laytonville Valley.

APPENDIX A

BASIC DATA

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Water levels	Construction survey	Water analyses: Mineral	Bacterial
		ANDERSON VALLEY										
13N/14W-2A1	0.6 mile east of State Highway 128 on unnamed road, 0.3 mile north of Mountain View Road.	R. Richard	Drilled	Domestic	—	—	—	Yes	—	Yes	—	—
13N/14W-2K1	East side of State Highway 128, north of Mountain View Road.	G. Lawson	Drilled	Domestic	56	34-56	8	—	—	Yes	—	Yes
13N/14W-2N1	South side of Mountain View Road, 0.4 mile west of State Highway 128.	Boalt Lumber Company	Drilled	Domestic and Industrial	—	—	—	Yes	Yes	Yes	—	—
13N/14W-2N5	800 feet south of Mountain View Road, 0.4 mile west of State Highway 128.	Babcock	Dug	Domestic	8	—	6	—	Yes	Yes	—	—
13N/14W-2P1	East side of Mill Creek Road, 0.3 mile west of State Highway 128.	M. Rawles	Drilled	Domestic	90	—	8	—	Yes	Yes	—	Yes
13N/14W-2Q1	West side of State Highway 128, 0.3 mile south of Mountain View Road.	Judge June	Drilled	Domestic	90	—	8	—	Yes	Yes	Yes	—
13N/14W-2R1	East side of State Highway 128, 0.6 mile north of Ukiah Boonville Cutoff.	Charles Lumber Company	Drilled	Domestic	—	—	—	Yes	—	Yes	—	Yes
13N/14W-3A1	0.3 mile west of State Highway 128 on unnamed road 0.7 mile north of Mountain View Road.	[illegible] Lumber Company	Drilled	Domestic and Industrial	—	—	—	Yes	Yes	Yes	—	Yes
13N/14W-3B1	0.5 mile west of State Highway 128 on unnamed road, 0.7 mile north of Mountain View Road.	T. H. Ornbaun	Dug	Domestic	30	—	—	—	Yes	Yes	—	—
13N/14W-11A3	West side of State Highway 128, 0.5 mile north of Ukiah Boonville Cutoff.	H. Charles	Drilled	Domestic	—	—	—	Yes	—	Yes	—	Yes
13N/14W-12E1	East side of State Highway 128, 0.2 mile north of Ukiah Boonville Cutoff.	F. H. Deely	Drilled	Domestic	155	—	8	—	—	Yes	—	—
13N/14W-12F1	South side of Ukiah Boonville Cutoff, 1,000 feet east of State Highway 128.	Johnson	Drilled	Domestic	—	—	8	—	Yes	Yes	—	—
13N/14W-12G1	North side of Ukiah Boonville Cutoff, 0.5 mile east of State Highway 128.	G. Ornbaun Jr.	Dug	Domestic and Stock	—	—	—	—	Yes	Yes	—	Yes
13N/14W-12M3	West side of State Highway 128, 500 feet south of Ukiah Boonville Cutoff.	Croft	Drilled	Domestic and Irrigation	75	—	8	—	Yes	Yes	Yes	—
13N/14W-12M5	South side of Ukiah Boonville Cutoff extended, 1,000 feet west of State Highway 128.	K. C. Croft	Drilled	Domestic	—	—	—	Yes	—	Yes	—	Yes
13N/14W-14A1	1.0 mile southwest of State Highway 128 on unnamed road intersecting State Highway 128 200 feet north of Ukiah Boonville Cutoff.	Bradford	Drilled	Abandoned	—	—	—	Yes	Yes	Yes	—	—
13N/14W-17M1	Northwest side of Whipple Ranch Road, 0.5 mile northeast of State Highway 128.	J. Ridley	Drilled	Domestic and Stock	—	—	8	—	Yes	Yes	—	—

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Water analyses: Mineral	Water analyses: Bacterial
14N/14W-18N1	North side of State Highway 128, 0.5 mile west of Philo.	A. H. Brown	Dug	Domestic	25	—	—	—	Yes	Yes	—	—
14N/14W-18R1	East side of Whipple Ranch Road, 800 feet north of State Highway 128.	F. Guntly	Dug	Domestic	35	—	60	—	Yes	Yes	—	Yes
14N/14W-18R2	South side of Highway 128, east of Highland Ranch Road.	A. Ray	Dug	Domestic	—	—	36	—	Yes	Yes	Yes	Yes
14N/14W-19A2	South side of State Highway 128, 0.2 mile southeast of Philo.	Philo Lumber Company	Drilled	Domestic	—	—	—	Yes	—	Yes	Yes	Yes
14N/14W-19B1	East side of Highland Ranch Road, 0.2 mile south of State Highway 128.	H. Eyles	Drilled	Domestic	110	—	—	Yes	—	Yes	Yes	Yes
14N/14W-19E1	West side of Rays Resort Road, 0.5 mile southwest of Highland Ranch Road.	A. Ray	Drilled	Domestic	—	—	—	Yes	—	Yes	—	Yes
14N/14W-19M1	North side of Highland Ranch Road, 1.6 miles south of State Highway 128.	J. Selby	—	Domestic	—	—	—	—	—	—	Yes	—
14N/14W-20E2	South side of State Highway 128, 0.8 mile southeast of Philo.	J. Peterson	Drilled	Irrigation	128	—	12	—	—	Yes	Yes	Yes
14N/14W-20F1	Northeast side of unnamed road, 0.6 mile northwest of intersection with State Highway 128, 1.2 miles southeast of Philo.	J. Dutro	Drilled	Domestic	150	—	—	—	—	Yes	—	—
14N/14W-20L1	Southeast corner of Tumbling Mc"D" Ranch Road and State Highway 128, 1.0 mile southeast of Philo.	K. W. Prather	Dug	Domestic	10	—	48	—	Yes	Yes	—	—
14N/14W-20R3	South side of State Highway 128, 1.6 miles southeast of Philo.	D. E. Phillips	Drilled	Domestic	—	—	—	Yes	—	Yes	—	Yes
14N/14W-28B1	North side of State Highway 128, 1.6 miles northwest of Peachland Road.	M. Rawles	Drilled	Irrigation	—	—	—	—	—	Yes	—	—
14N/14W-28K1	South side of State Highway 128, 1.2 miles northwest of Peachland Road.	Rawles	Dug	Domestic	38	—	36	—	Yes	Yes	Yes	Yes
14N/14W-28R1	South side of State Highway 128, 0.9 mile northwest of Peachland Road.	E. Kinvila	Dug	Domestic	16	—	36	—	Yes	Yes	—	Yes
14N/14W-34C1	Southwest side of State Highway 128, 0.2 mile northwest of Peachland Road.	Whiting	Drilled	Domestic	—	—	—	Yes	—	Yes	Yes	—
14N/14W-34G2	Southwest side of State Highway 128, opposite Peachland Road, on southeast side of Con Creek.	B. Crispin	Dug	Domestic	—	—	24	—	Yes	Yes	Yes	Yes
14N/14W-34G6	500 feet southwest of State Highway 128, 0.2 mile southeast of Peachland Road.	Anderson Union High School	Drilled	Domestic	130	—	—	—	—	Yes	Yes	—
14N/14W-34H2	Northeast side of State Highway 128, 500 feet southeast of Peachland Road.	Wellington	Drilled	Domestic	90	—	8	—	Yes	Yes	—	—
14N/14W-34J2	Northeast side of State Highway 128, 0.4 mile southeast of Peachland Road.	B. Hansen	Drilled	Domestic	—	—	—	Yes	—	Yes	—	Yes
14N/14W-34K3	Southwest side of State Highway 128, 0.3 mile southeast of Peachland Road.	W. E. Slater	Drilled	Domestic	—	—	—	Yes	—	Yes	—	Yes

TABLE 1
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Data available: Water analyses: Mineral	Data available: Water analyses: Bacterial
14N/14W-34R2	Northeast side of State Highway 128, 1.0 mile northeast of Mountain View Road.	W. Rapp	Drilled	Domestic	—	—	—	Yes	—	Yes	—	—
14N/14W-34R4	Southwest side of State Highway 128, 1.0 mile northeast of Mountain View Road.	D. H. June	Dug	Domestic	—	—	36	—	Yes	Yes	—	—
14N/14W-35N3	Northeast side of State Highway 128, 0.8 mile northeast of Mountain View Road.	M. McCready	Drilled	Domestic	—	—	—	Yes	—	Yes	—	Yes
14N/15W-2D1	North side of Lazy Creek, 0.3 mile northeast of State Highway 128, 1.2 miles northeast of Greenwood Ridge Road.	Day	Dug	Domestic	—	—	36	—	Yes	Yes	—	—
14N/15W-2Q1	Northeast side of State Highway 128, 0.4 mile northwest of Greenwood Ridge Road.	Gossman	Drilled	Domestic	—	—	—	Yes	—	Yes	Yes	Yes
14N/15W-11H1	Northeast side of State Highway 128, opposite Greenwood Ridge Road.	J. B. Williams	Dug	Domestic	27	—	24	—	Yes	Yes	—	—
14N/15W-11K1	Southeast side of Greenwood Ridge Road, northeast of Navarro River bridge.	G. J. Bennett	Dug	Domestic	—	—	36	—	Yes	Yes	—	Yes
14N/15W-12L1	0.2 mile northeast of State Highway 128, 0.7 mile southeast of Greenwood Ridge Road.	C. Hulbert	Drilled	Domestic	—	—	—	Yes	—	Yes	—	—
14N/15W-13H1	Northeast side of State Highway 128, 1.0 mile northwest of Philo.	Hollifield Lumber Company	Drilled	Domestic	—	—	—	Yes	—	Yes	—	Yes
		SANEL VALLEY										
12N/11W-2F1	0.1 mile west of U.S. Highway 101, 3.2 miles southeast of Russian River Bridge, at Pieta.	A. DeMarcantonio	Drilled	Domestic	—	—	—	Yes	—	Yes	Yes	Yes
13N/11W-7D1	0.1 mile east of U.S. Highway 101, 2.3 miles north of Hopland Road.	State Division of Forestry	Drilled	Domestic	—	—	12	—	Yes	Yes	—	Yes
13N/11W-7E1	West side of U.S. Highway 101, 2.3 miles north of Hopland Road.	State Division of Forestry	Drilled	Abandoned	—	—	12	—	Yes	Yes	—	—
13N/11W-7J1	West side of East Valley Road, 2.0 miles north of Hopland bridge.	Cal Dri-Ice Corporation	Drilled	Industrial	1,100	—	12	—	Yes	Yes	Yes	—
13N/11W-7P1	0.1 mile east of U.S. Highway 101, 1.7 miles north of Hopland Road, east of Northwestern Pacific Railroad.	Barber	Drilled	Irrigation	60	—	12	—	Yes	Yes	—	—
13N/11W-15R1	0.3 mile north of Hopland Road, 1.2 miles east of Highland Springs Road.	McAfee	Dug	Irrigation	17	—	10	—	Yes	Yes	—	—
13N/11W-17E1	West side of East River Road, 0.7 mile north of Hopland Road.	J. I. Haas	Dug	Domestic	12	—	72	—	Yes	Yes	—	Yes
13N/11W-17R1	South side of University Road, 0.7 mile east of East River Road.	G. E. Wood	Dug	Domestic	—	—	—	—	Yes	Yes	—	—

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Data available: Water analyses: Mineral	Data available: Water analyses: Bacterial
13N/11W-18D1	West side of U.S. Highway 101, 1.4 miles north of Hopland Road.	Barber	Drilled	Irrigation	—	—	—	Yes	—	Yes	—	—
13N/11W-18K2	0.4 mile east of U.S. Highway 101, 1.0 mile north of Hopland Road.	Renfro	Drilled	Irrigation	52	—	12	—	Yes	Yes	—	—
13N/11W-18M1	West side of U.S. Highway 101, 1.0 mile north of Hopland Road.	Renfro	Drilled	Irrigation	45	—	8	—	Yes	Yes	—	—
13N/11W-18Q1	0.3 mile east of U.S. Highway 101, 0.8 mile north of Hopland Road.	Renfro	Drilled	Irrigation	52	—	12	—	—	Yes	Yes	—
13N/11W-19C1	0.2 mile east of U.S. Highway 101, 0.5 mile north of Hopland Road.	J. F. Manning	Drilled	Irrigation	—	—	—	Yes	Yes	Yes	—	—
13N/11W-19D1	West side of U.S. Highway 101, 0.5 mile north of Hopland Road.	W. Cierck	Dug	Irrigation	37	—	36	—	Yes	Yes	—	Yes
13N/11W-19J1	North side of Hopland Road, 0.5 mile east of U.S. Highway 101.	J. I. Haas	Drilled	Domestic	30	—	8	—	—	Yes	—	—
13N/11W-19L1	Southeast corner of intersection of Hopland Road and Northwestern Pacific Railroad.	F. J. Helman	Dug 20 Drilled 30	Domestic and Irrigation	50	—	120 Dug 8 Drilled	—	Yes	Yes	—	Yes
13N/11W-19M1	200 feet south of Feliz Creek Bridge, 100 feet west of Boonville Road.	Pacific Gas and Electric Company	Drilled	Domestic	60	40-60	36 and 18	—	Yes	Yes	Yes	—
13N/11W-19N1	1,000 feet south of Hopland Road, 1,000 feet east of Northwestern Pacific Railroad, on north side Feliz Creek.	R. Morgan	Drilled	Irrigation	60	—	12	—	—	Yes	—	—
13N/11W-20C1	South side University Road at junction with East River Road.	J. Barratti	Drilled	Domestic	—	—	—	Yes	—	Yes	Yes	Yes
13N/11W-20E1	Southeast side of Harrison Street, 500 feet southwest of Hopland Road.	L. C. Faught	Drilled	Domestic	43	—	12	—	Yes	Yes	—	Yes
13N/11W-20E2	Northwest side of Hopland Road, 0.3 mile southwest of junction with East River Road.	J. Rosetti	Dug	Domestic	32	—	24	—	Yes	Yes	—	Yes
13N/11W-20E3	Southeast side of Hopland Road, 0.3 mile southwest of junction with East River Road.	Rosetti	Dug	Domestic	—	—	48	—	Yes	Yes	—	Yes
13N/11W-20G1	North side of Hopland Road, 0.5 mile east of East River Road.	McKee	Drilled	Domestic	135	—	8	—	Yes	Yes	—	—
13N/11W-20H1	Southside of Hopland Road, 0.7 mile east of East River Road.	H. Dawe	Dug	Domestic	35	—	30	—	Yes	Yes	—	—
13N/11W-21C1	North side of Hopland Road, 0.3 mile west of Highland Springs Road.	McKee	Drilled	Domestic and Stock	100	—	6	—	—	Yes	—	—
13N/11W-21L1	0.3 mile south of Hopland Road, 0.5 mile west of Highland Springs Road, on south side of McDowell Creek.	Middle Ridge Ranch Company	Drilled	Irrigation	—	—	—	Yes	Yes	Yes	Yes	—
13N/11W-21Q1	0.7 mile south of Hopland Road, 0.7 mile west of Highland Springs Road.	C. Fitzgerald	Drilled	Irrigation	—	—	—	Yes	—	Yes	—	—
13N/11W-21Q2	0.75 mile south of Hopland Road, 0.7 mile west of Highland Springs Road.	C. Fitzgerald	Drilled	Irrigation	—	—	—	Yes	Yes	Yes	—	—

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available				
								Log	Water levels	Construction survey	Water analyses	
											Mineral	Bacterial
13N/11W-22B1	North side of Hopland Road, 0.9 mile east of Highland Springs Road.	Cinnamond	Drilled	Domestic	50	—	8	—	Yes	Yes	—	—
13N/11W-22H1	800 feet south of Hopland Road, 1.1 miles east of Highland Springs Road.	D. L. MacFarlane	Dug	Domestic	20	—	60	—	Yes	Yes	Yes	Yes
13N/11W-22H2	0.3 mile south of Hopland Road, 1.1 miles east of Highland Springs Road.	D. L. MacFarlane	Spring	Domestic	—	—	—	—	—	—	Yes	—
13N/11W-23C1	North side of Hopland Road, 1.6 miles east of Highland Springs Road.	F. E. Gibson	Dug	Domestic and Irrigation	25	—	36	—	—	Yes	—	—
13N/11W-28C1	0.9 mile south of Hopland Road, 1.0 miles west of Highland Springs Road.	C. Fitzgerald	Drilled	Domestic	200	—	—	—	—	Yes	—	—
13N/11W-29C1	North side of unnamed road, 0.2 mile east of East River Road, 0.9 mile north of junction of East River Road and U.S. Highway 101.	Ponzio	Dug	Domestic	25	—	36	—	Yes	Yes	—	Yes
13N/11W-29P1	South side of U.S. Highway 101, 0.2 mile east of East River Road.	A. Baker	Drilled	Domestic	20	—	12	—	Yes	Yes	—	—
13N/11W-30D1	0.2 mile west of Boonville Road, 0.2 mile south of Feliz Creek bridge.	E. Johnson	Dug	Domestic	25	—	36	—	Yes	Yes	—	Yes
13N/11W-30H1	0.2 mile west of East River Road, 0.6 mile north of U.S. Highway 101.	Grace	Drilled	Domestic, Irrigation Stock	—	—	12	—	—	Yes	—	—
13N/11W-30J1	North side of U.S. Highway 101, 0.5 mile west of East River Road.	F. Milone	Drilled	Domestic	40	—	12	—	Yes	Yes	Yes	Yes
13N/11W-32A1	South side of U.S. Highway 101, 0.7 mile east of East River Road.	Norfolk	Drilled	Domestic and Irrigation	28	—	12	—	Yes	Yes	—	—
13N/11W-33N1	0.2 mile east of Boonville Road, 3.2 miles southeast of Feliz Creek bridge on Boonville Road.	R. Bradford	Drilled	Irrigation	—	—	—	Yes	—	Yes	—	—
13N/11W-35E1	Southwest side of Highland Springs Road, 2.5 miles southeast of Hopland Road.	A. Lucchett	Dug	Domestic	—	—	60	—	Yes	Yes	—	—
13N/12W-1C1	West side of U.S. Highway 101, 3.5 miles north of Hopland Road.	P. C. Crawford	Dug	Stock and Spraying	—	—	72	—	Yes	Yes	Yes	—
13N/12W-1K1	West side of U.S. Highway 101, 3.0 miles north of Hopland Road.	Hawn	Drilled	Domestic	40	—	12	—	—	Yes	—	—
13N/12W-15D1	South side of Feliz Creek Road, 2.5 miles west of Duncan Creek Road.	Grant	Dug	Stock and Irrigation	15	—	60	—	Yes	Yes	—	—
13N/12W-24F1	North side of Feliz Creek Road, 0.4 mile east of Duncan Creek Road.	P. H. Hopper	Drilled	Domestic	29	21-29	12	—	Yes	Yes	—	Yes
13N/12W-24J1	South side of Feliz Creek Road, 0.4 mile west of U.S. Highway 101.	A. Cooper	Dug 25 Drilled 40	Domestic and Irrigation	65	—	60 Dug 10 Drilled	—	Yes	Yes	—	Yes

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Water levels	Construction survey	Water analyses: Mineral	Bacterial
13N/12W-24Q1	0.2 mile south of Feliz Creek Road, 0.6 mile west of U.S. Highway 101, on south side Feliz Creek.	C. Johnson	Dug 20 Drilled 30	Domestic	50	—	60 Dug 8 Drilled	—	—	Yes	—	—
13N/12W-26K1	East side of Duncan Creek Road, 1.5 miles south of Feliz Creek.	J. Germano	Drilled	Domestic	17	—	12	—	—	Yes	—	—
		LAYTONVILLE VALLEY										
21N/14W-19N1	Northeast corner of intersection of Davison Lane and U.S. Highway 101.	J. E. Gates	Drilled	Domestic	—	—	—	Yes	Yes	Yes	Yes	Yes
21N/14W-19Q1	East side of Davison Lane, 0.7 mile east of U.S. Highway 101, east side of Ten Mile Creek.	--	Drilled	Domestic	40	—	8	—	—	Yes	—	—
21N/14W-29N1	1.1 miles northeast of U.S. Highway 101 on unnamed road, 1.4 miles south of Steel Lane.	C. W. Myers	Dug	Domestic	14	—	36	—	Yes	Yes	—	—
21N/14W-30C1	South side of Davison Lane, 0.4 mile east of U.S. Highway 101.	J. Contrell	Drilled	Domestic and Irrigation	—	—	—	Yes	—	Yes	—	—
21N/14W-30D1	South side of Davison Lane, 900 feet east of U.S. Highway 101.	O. Bramlet	Drilled	Domestic	--	—	--	Yes	Yes	Yes	—	—
21N/14W-30F1	South side of Ten Mile Creek, 0.5 mile west of U.S. Highway 101, 0.4 mile south of Davison Lane.	R. Maehler	Drilled	Domestic	30	—	8	—	Yes	Yes	—	Yes
21N/14W-30K1	0.5 mile east of U.S. Highway 101, 0.6 mile south of Davison Lane.	C. Merrill	Dug	Domestic and Stock	20	—	48 and 36	—	Yes	Yes	Yes	Yes
21N/14W-30M1	East side of U.S. Highway 101, 0.6 mile south of Davison Lane.	M. Tracy	Dug	Domestic and Irrigation	--	--	—	Yes	Yes	Yes	—	—
21N/14W-30P1	West side of U.S. Highway 101, 0.9 mile south of Steel Lane.	R. Lowe	Drilled	Domestic	38	—	8	—	Yes	Yes	—	—
21N/14W-31F1	West side of U.S. Highway 101, 1.3 miles south of Steel Lane.	Stone Canyon Sawmill	Drilled	Domestic	57	—	6	—	—	Yes	—	Yes
21N/14W-31J1	500 feet east of U.S. Highway 101, 1.8 miles south of Steel Lane.	G. Newhall	Drilled	Irrigation	--	—	—	Yes	—	Yes	Yes	—
21N/15W-1K1	East side of U.S. highway 101, 1.0 mile north of Dos Rios Road.	State Division of Forestry	Drilled	Domestic and Fire control	65	—	8	—	—	Yes	Yes	—
21N/15W-1L1	West side of U.S. Highway 101, 0.9 mile north of Dos Rios Road.	Wilson	Dug	Stock	28	—	48	—	Yes	Yes	—	Yes
21N/15W-10R1	North side of Carrol Lane, 0.9 mile north of Branscomb Road.	W. Comer	Dug	Domestic	18	—	36	—	Yes	Yes	—	Yes
21N/15W-11J1	North side of Carrol Lane, 0.3 mile west of Branscomb Road.	R. Davison	Drilled	Domestic	—	—	—	Yes	Yes	Yes	—	Yes

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available				
								Log	Water levels	Construction survey	Water analyses	
											Mineral	Bacteriol
21N/15W-11J2	South side of Carrol Lane, 800 feet west of Branscomb Road.	L. Shepard	Drilled	Domestic	—	—	—	Yes	—	—	—	—
21N/15W-11R1	West side of Branscomb Road, 0.4 mile south of Carrol Lane.	Strickland	Dug	Domestic	16	—	48	—	Yes	Yes	—	—
21N/15W-11R2	West side of Branscomb Road, 0.3 mile south of Carrol Lane.	P. Oldenburg	Dug	Domestic	30	—	48	—	Yes	Yes	Yes	—
21N/15W-12C1	West side of U.S. Highway 101, 0.5 mile north of Doe Rios Road.	Cutler	Drilled	Domestic	—	—	—	Yes	—	Yes	Yes	Yes
21N/15W-12C2	West side of U.S. Highway 101, 0.4 mile north of Dos Rios Road.	Cutler	Drilled	Abandoned	65	—	12	—	Yes	Yes	Yes	—
21N/15W-12C3	0.3 mile west of U.S. Highway 101, 0.3 mile north of Dos Rios Road.	O. L. Pinches	Dug	Domestic	—	—	—	Yes	Yes	Yes	—	Yes
21N/15W-12F1	North side of Branscomb Road, 1,000 feet west of U.S. Highway 101.	Laytonville High School	Drilled	Abandoned	—	—	—	Yes	—	Yes	—	—
21N/15W-12K1	Southeast corner of Ramsey Road and Willis Avenue.	Laytonville Water Company	Drilled	Domestic	—	—	—	Yes	—	—	—	—
21N/15W-12K2	Northeast corner of Ramsey Road and Willis Avenue.	Laytonville School	Drilled	Abandoned	50	—	8	—	—	Yes	—	—
21N/15W-12Q1	West side of Willis Avenue, 700 feet south of Ramsey Road.	L. Berchtold	Dug	Domestic	25	—	36	—	—	Yes	—	Yes
21N/15W-13B1	West side of Willis Avenue, 0.3 mile south of Ramsey Road.	Laytonville Water Company	Drilled	Municipal	—	—	—	Yes	—	Yes	Yes	—
21N/15W-13G1	0.4 mile west of U.S. Highway 101, 1.0 mile south of Dos Rios Road, east bank of Ten Mile Creek.	Jansen	Drilled	Irrigation	—	—	—	Yes	Yes	Yes	—	—
21N/15W-14A1	West side of Branscomb Road, 0.7 mile south of Carrol Lane.	C. C. Brown	Drilled	Domestic	—	—	—	Yes	Yes	Yes	Yes	Yes
21N/15W-14F1	North side of Branscomb Road, 0.4 mile east of Carrol Lane.	R. D. Smith	Dug	Domestic	22	—	36	—	Yes	Yes	—	Yes
21N/15W-22A1	South side of Branscomb Road, 0.6 mile south of Carrol Lane.	B. Mast	Drilled	Domestic	25	—	8	—	Yes	Yes	—	—
21N/15W-24A1	West side of U.S. Highway 101, 1.0 mile north of Steel Lane.	R. Evans	Dug	Domestic	—	—	—	Yes	Yes	Yes	Yes	Yes
21N/15W-24H1	West side of U.S. Highway 101, 0.7 mile north of Steel Lane.	R. H. Watson	Drilled	Domestic and Irrigation	50	—	8	—	Yes	Yes	—	—
21N/15W-24J1	West side of U.S. Highway 101, 0.4 mile north of Steel Lane.	Red Hill Motel	Dug	Domestic	15	—	36	—	Yes	Yes	—	Yes
21N/15W-24L1	0.6 mile west of U.S. Highway 101, 0.5 mile north of Steel Lane, west side Ten Mile Creek.	Jung	Dug	Stock	22	—	36	—	Yes	Yes	—	—
21N/15W-24N1	North side of Steel Lane, 1.0 mile west of U.S. Highway 101.	G. Oden	Dug	Domestic	34	—	60	—	Yes	Yes	Yes	—
21N/15W-24R1	North side of Steel Lane, 0.2 mile west of U.S. Highway 101.	Kelton	Dug	Domestic	30	—	72 and 48	—	Yes	Yes	—	—
21N/15W-25C1	South side of Steel Lane, 0.6 mile west of U.S. Highway 101.	H. N. Thompson	Dug	Domestic	34	—	48	—	Yes	Yes	—	—

TABLE 1
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Water analyses: Mineral	Water analyses: Bacterial
21N/15W-26B1	South side of Steel Lane, 1.4 miles west of U.S. Highway 101.	F. Kirkpatrick	Dug	Domestic	30	—	48	—	Yes	Yes	—	Yes
22N/15W-22E1	0.1 mile south of U.S. Highway 101, on west side of Ten Mile Creek, 5.3 miles north of Dos Rios Road.	G. Daniels	Drilled	Domestic and Stock	78	—	6	—	Yes	Yes	Yes	Yes
22N/15W-26E1	West side of U.S. Highway 101, 3.7 miles north of Dos Rios Road, east side of Ten Mile Creek.	B. Branscomb Lumber Mill	Dug	Domestic	12	—	60	—	—	Yes	—	—
22N/15W-35B1	West side of U.S. Highway 101, 2.8 miles north of Dos Rios Road.	W. Woodruff	Dug	Domestic	18	—	48	—	Yes	Yes	Yes	Yes
		LITTLE LAKE VALLEY										
18N/13W-5D1	0.7 mile east of U.S. Highway 101, 0.9 mile north of Northwestern Pacific Railroad crossing.	E. H. Maize	Drilled	Irrigation	—	—	—	Yes	—	—	—	—
18N/13W-6G1	0.6 mile east of U.S. Highway 101, 0.5 mile north of Northwestern Pacific Railroad crossing.	E. H. Maize and Sons	Drilled	Irrigation	—	—	—	Yes	—	Yes	—	—
18N/13W-7M1	West side of U.S. Highway 101, 0.7 mile north of Sherwood Valley Road.	R. H. Corbett	Drilled	Irrigation	—	—	—	Yes	—	Yes	—	—
18N/13W-7M2	500 feet west of U.S. Highway 101, 0.7 mile north of Sherwood Valley Road.	R. H. Corbett	Drilled	Stock	—	—	—	Yes	—	Yes	—	—
18N/13W-8H1	0.2 mile north of Hearst Road, 1.0 mile west of Eastside Road.	—	Dug	Domestic	4	—	48	—	Yes	Yes	—	—
18N/13W-8K1	West side of Hearst Road, 0.8 mile north of Valley Road.	G. Mott	Drilled	Domestic	—	—	—	Yes	—	Yes	Yes	—
18N/13W-8K2	East side of Hearst Road, 0.9 mile north of Valley Road.	A. Hall	Dug	Domestic	15	—	48	—	Yes	Yes	—	Yes
18N/13W-8P1	0.2 mile west of Hearst Road, 0.6 mile north of Valley Road on east side of Davis Creek.	I. Washburn	Drilled	Stock and Irrigation	—	—	—	Yes	Yes	Yes	—	—
18N/13W-8Q1	West side of Hearst Road, 0.8 mile north of Valley Road.	I. Washburn	Dug	Domestic	30	—	48	—	Yes	Yes	—	Yes
18N/13W-9E1	North side of Hearst Road, 0.8 mile west of Eastside Road.	C. W. Codington	Drilled	Domestic	60	—	6	—	—	Yes	—	Yes
18N/13W-9M1	500 feet south of Hearst Road, 0.7 mile west of Eastside Road.	R. A. Barkhurst	Drilled	Domestic	—	—	—	Yes	—	Yes	—	Yes
18N/13W-16K1	South side Valley Road, 0.5 mile west of Eastside Road.	J. G. Lalee	Dug	Domestic	17	—	—	—	—	Yes	—	Yes
18N/13W-16R1	East side of Eastside Road, 0.5 mile south of Valley Road.	E. Tenny	Drilled	Domestic	80	—	8	—	—	Yes	—	Yes
18N/13W-17J1	North side of Valley Road, 0.3 mile east of Hearst Road.	A. F. Lawrason	Dug	Domestic	25	—	—	—	—	Yes	—	Yes
18N/13W-17L1	South side of Hearst Road, 0.4 mile west of Valley Road.	—	—	Domestic	—	—	—	—	—	Yes	—	—
18N/13W-17L2	500 feet south of Hearst Road, 0.4 mile west of Valley Road.	E. Bray	Drilled	Domestic	96	—	12	—	Yes	Yes	—	Yes
18N/13W-17N1	Southwest corner of West Valley Street and Central Valley Road.	E. McPhillips	Dug	Domestic and Stock	14	—	48	—	—	Yes	—	Yes

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Water levels	Construction survey	Water analyses: Mineral	Bacterial
18N/13W-18H1	500 feet north of Hearst Road, 0.7 mile west of Northwestern Pacific Railroad.	D. Coleman	Drilled	Irrigation	--	--	—	Yes	—	Yes	Yes	—
18N/13W-18Q1	800 feet south of West Valley Street, 0.4 mile east of Northwestern Pacific Railroad.	A. L. Kaser	Dug	Domestic	28	—	60	—	Yes	Yes	—	Yes
18N/13W-18R1	0.3 mile south of West Valley Street, 0.5 mile east of Northwestern Pacific Railroad.	A. L. Kaser	Drilled	Irrigation	82	—	8	—	—	Yes	—	—
18N/13W-19B1	East side of Northwestern Pacific Railroad, 0.3 mile south of West Valley Street.	P. Colli	Drilled	Irrigation	--	—	—	Yes	—	Yes	—	—
18N/13W-20A1	West side of Central Valley Road, 0.7 mile north of East Hill Road.	C. Higgs	Drilled	Domestic	82	—	6	—	Yes	Yes	Yes	Yes
18N/13W-20C1	West side of unnamed road, 1,000 feet south of Central Valley Road, 0.8 mile east of Northwestern Pacific Railroad.	D. Case	Dug	Domestic	14	—	36	—	Yes	Yes	—	—
18N/13W-20D1	South side of Central Valley Road, 0.5 mile south of Hearst Road.	C. Swift	Dug	Domestic	28	—	48	—	—	Yes	—	—
18N/13W-20G1	0.3 mile west of Central Valley Road, 0.4 mile north of East Hill Road.	H. Sawyers	Dug	Domestic	12	—	48	—	—	Yes	—	Yes
18N/13W-20H1	East side of Central Valley Road, 0.3 mile north of East Hill Road.	E. O. Reed	Drilled	Domestic	17	—	8	—	—	Yes	—	—
18N/13W-28A1	East side of Eastside Road, 800 feet south of East Hill Road.	J. W. Bartow	Dug	Irrigation and Stock	25	—	36	—	Yes	Yes	—	—
18N/13W-29C1	South side of East Hill Road, 0.5 mile east of Northwestern Pacific Railroad.	W. Burrell	Drilled	Domestic	—	—	--	Yes	Yes	Yes	—	Yes
18N/13W-29D1	South side of East Hill Road, 800 feet east of Northwestern Pacific Railroad.	E. Hayes	Drilled	Domestic	87	—	8	—	—	Yes	—	Yes
18N/13W-29J1	0.9 mile south of East Hill Road, 0.6 mile east of Northwestern Pacific Railroad.	F. Olson	Drilled	Domestic	—	—	—	Yes	—	—	—	—
18N/13W-29L1	0.7 mile south of East Hill Road, 800 feet east of Northwestern Pacific Railroad.	Schmidbauer	Drilled	Abandoned	105	—	8	--	—	Yes	—	—
18N/13W-30Q1	West side of U.S. Highway 101, 1.7 miles south of California Western Railroad and Navigation Company tracks.	Maize	Dug	Abandoned	20	—	36	—	Yes	Yes	—	—
18N/13W-31A1	West side of U.S. Highway 101, 1.3 miles north of Northwestern Pacific Railroad crossing.	J. Delso	Drilled	Domestic	289	—	8	Yes	—	Yes	—	—
18N/14W-1R1	500 feet west of U.S. Highway 101, 1,000 feet south of Northwestern Pacific Railroad crossing.	B. H. Garmon	Dug	Domestic	22	—	24	—	—	Yes	—	Yes
18N/14W-2P1	1.4 miles northwest of U. S. Highway 101 on Sherwood Valley Road, thence 0.6 mile northwest on unnamed road.	Anderson	Dug	Domestic	14	—	42	Yes	—	—	Yes	—
18N/14W-12A1	West side of U.S. Highway 101, 0.5 mile south of Northwestern Pacific Railroad crossing.	R. E. Sanders	Drilled	Domestic	71	—	6	—	—	Yes	—	Yes

TABLE 1
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available				
								Log	Water levels	Construction survey	Water analyses	
											Mineral	Bacterial
18N/14W-12H1	West side of U.S. Highway 101, 0.7 mile south of Northwestern Pacific Railroad crossing.	R. E. Sanders	Drilled	Domestic	71	—	6	—	—	Yes	Yes	—
18N/14W-12H2	West side of U.S. Highway 101, 0.8 mile south of Northwestern Pacific Railroad crossing.	Rock Garden Courts	Dug	Domestic	—	—	—	—	Yes	Yes	—	Yes
18N/14W-13N1	North side of Fort Bragg Road, 1.1 miles west of U.S. Highway 101.	J. S. Long	Dug	Stock and Domestic	12	—	36	—	—	Yes	Yes	Yes
18N/14W-14P1	North side of Fort Bragg Road, 1.9 miles west of U.S. Highway 101.	Bassett	Drilled	Domestic and Stock	—	—	—	Yes	Yes	Yes	—	Yes
18N/14W-14Q1	North side of Fort Bragg Road, 1.3 miles west of U.S. Highway 101.	B. M. Snyder	Drilled	Domestic	—	—	—	Yes	Yes	Yes	—	—
18N/14W-24F1	0.3 mile south of Fort Bragg Road, 0.3 mile west of U.S. Highway 101.	H. C. Councilman	Dug	Abandoned	20	—	48	—	Yes	Yes	—	—
19N/13W-31C1	East side of U.S. Highway 101, 500 feet north of Outlet Creek bridge.	B. Shedd	Spring	Domestic and Stock	6	—	—	—	—	Yes	Yes	Yes
19N/13W-33M1	0.5 mile west of intersection of Hearst Road and Eastside Road, thence 0.5 mile north on unnamed road, thence 1.8 miles northwest on unnamed dirt road, thence 0.5 mile east of road.	K. Butin	Spring	Domestic	—	—	72	—	—	Yes	—	—
		POTTER VALLEY										
16N/11W-4B1	South side of Burris Lane, 0.55 mile east of intersection of Eastside Road and Burris Lane.	S. C. Burris	Dug	Domestic	18	—	60	—	Yes	Yes	—	—
16N/11W-4M1	0.55 mile southeast of Eastside Road and Westside Road Junction, 300 feet north of Mewhinney Creek.	—	—	Domestic	—	—	—	—	—	Yes	—	—
16N/11W-5G1	300 feet northeast of Eastside Road and Westside Road Junction, 400 feet west of East Fork Russian River.	L. T. Hotell	Drilled	Domestic	38	—	8	—	Yes	Yes	Yes	Yes
16N/11W-5P1	0.5 mile southwest of Westside Road and Eastside Road Junction, 200 feet south of Potter Valley Road.	F. Guntly	Drilled	Domestic	26	—	12	—	Yes	Yes	—	—
17N/11W-6C1	North side of Powerhouse Road, 0.15 mile east of Potter Valley Power House.	A. R. Hughes	Drilled	Domestic	22	—	6	—	—	Yes	—	—
17N/11W-6E1	South side of Powerhouse Road east side of Potter Valley Power House, behind Quonset Hut.	Pacific Gas and Electric Company	Drilled	Domestic	54	—	8	—	Yes	Yes	Yes	Yes
17N/11W-7B1	East side of Powerhouse Road, 0.4 mile north of intersection with Bush Road, north side East Fork Russian River.	E. Noyes	Dug	Domestic	40	—	60	—	Yes	Yes	—	Yes
17N/11W-7H1	East side of Powerhouse Road, 300 feet south of intersection with Bush Road.	J. Linsey	Dug	Domestic	34	—	72	—	Yes	Yes	—	—

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Water analyses: Mineral	Water analyses: Bacteriol
17N/11W-7N1	800 feet north of Gibson Lane, 0.3 mile west of Powerhouse Road.	E. Wright	Drilled	Domestic	45	--	10	--	Yes	Yes	--	--
17N/11W-7R1	North side of Gibson Lane, 0.2 mile east of intersection with Westside Road, on south side of Bush Creek.	F. Gibson	Dug	Domestic	34	--	72	--	Yes	Yes	--	Yes
17N/11W-8F1	West side of Pillsbury Road, 0.7 mile north of Gibson Lane.	A. F. Whitaker	Dug	Domestic	16	--	96	--	Yes	Yes	Yes	--
17N/11W-8L1	West side of Pillsbury Road, 0.4 mile north of Gibson Lane.	R. S. Odell and Company	Drilled	Domestic	19	--	8	--	Yes	Yes	--	--
17N/11W-8P1	Northwest corner of Pillsbury Road and Gibson Lane.	H. S. Martin	Dug	Domestic	19	--	36	--	Yes	Yes	--	--
17N/11W-17E1	East side of Westside Road, 0.6 mile north of Cross Road, south side of Hawn Creek.	G. Phillips	Drilled	Domestic Irrigation Stock	100	--	8	--	Yes	Yes	--	--
17N/11W-17G1	East side of Pillsbury Road, 0.3 mile south of Gibson Lane.	T. Hopper	Drilled	Domestic	21	--	6	--	--	Yes	--	--
17N/11W-17K1	West of Pillsbury Road, 0.3 mile north of Cross Road.	Anwyl and Moody	Drilled	Domestic Stock Irrigation	200	--	8	--	Yes	Yes	Yes	Yes
17N/11W-17M1	700 feet east of Westside Road, 0.3 mile north of Cross Road.	D. Smith	Drilled	Domestic	50	--	8	--	Yes	Yes	--	--
17N/11W-17N1	North side of Cross Road, 0.2 mile east of Westside Road.	Smalley	Drilled	Domestic	56	53-56	8	--	Yes	Yes	--	--
17N/11W-17P1	North side of Cross Road, 0.3 mile west of Pillsbury Road.	A. B. Crafts	Drilled	Domestic	36	30-36	8	--	Yes	Yes	--	--
17N/11W-17R1	North side of Cross Road, 0.2 mile east of Pillsbury Road.	J. Burton	Dug	Domestic and Stock	--	--	30	--	Yes	Yes	--	--
17N/11W-18A1	South side of Gibson Lane, 600 feet east of Westside Road.	J. W. Fraser	Drilled	Domestic	60	--	8	--	Yes	Yes	--	--
17N/11W-18A2	500 feet east of Westside Road, 1,000 feet south of Gibson Lane.	J. W. Fraser	Drilled	Irrigation	60	--	12	--	--	Yes	Yes	--
17N/11W-18C1	South side of Gibson Lane, 0.5 mile west of Westside Road.	G. S. Farnsworth	Drilled	Domestic and Stock	70	--	6	--	--	Yes	--	--
17N/11W-18G1	North side of unnamed road, 0.2 mile west of Westside Road, 0.4 mile south of Gibson Lane south side of Hawn Creek.	Byers	Dug	Domestic	19	--	36	--	Yes	Yes	--	--
17N/11W-18M1	East side of Rancho Rio Road, 0.4 mile north of Cross Road, south side of Hawn Creek.	T. H. Swigart	Dug	Domestic and Stock	26	--	60	--	Yes	Yes	--	--
17N/11W-18N1	North side of Cross Road, 0.2 mile east of Rancho Rio Road.	C. Eddie	Dug	Domestic and Stock	40	--	48	--	Yes	Yes	--	Yes
17N/11W-18Q1	North side of Cross Road, 0.3 mile west of Westside Road.	D. Hulbert	Drilled	Domestic and Stock	40	--	8	--	Yes	Yes	--	Yes

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Data available: Water analyses: Mineral	Data available: Water analyses: Bacterial
17N/11W-19A1	West side of Westside Road, 0.2 mile south of Cross Road.	P. R. and R. M. Whitcomp	Drilled	Domestic and Stock	44	—	8	—	Yes	Yes	—	—
17N/11W-19F1	0.3 mile south of Cross Road, 0.6 mile west of Westside Road.	W. T Eddie	Dug	Domestic	—	—	36	—	Yes	Yes	—	—
17N/11W-19N1	West side of Rancno Rio Road, 1.0 mile west of Westside Road.	Harrison	Dug	Domestic	30	—	48	—	Yes	Yes	Yes	Yes
17N/11W-19N2	West side of Rancho Rio Road, 1.0 mile west of Westside Road.	Harrison	Drilled	Domestic	125	—	12	—	—	Yes	—	—
17N/11W-19R1	West side of Westside Road, 0.2 mile north of Rancho Rio Road.	Moller	Drilled	Domestic	96	—	8	—	Yes	Yes	—	Yes
17N/11W-20C1	South end of Potter Valley High School Atheletic Field, 0.1 mile south of Cross Road.	Potter Valley High School	Drilled	Municipal	—	—	8	—	—	Yes	—	Yes
17N/11W-20D1	Southeast corner of intersection of Cross Road and Westside Road.	Adams	Drilled	Domestic	60	—	6	—	—	Yes	—	Yes
17N/11W-20H1	West side of Eastside Road, 0.3 mile south of Cross Road.	H. H. Dickey	Dug	Domestic	25	—	36	—	Yes	Yes	—	—
17N/11W-20M1	East side of Westside Road, 0.6 mile south of Cross Road.	Kirchmeier	Dug	Domestic and Stock	—	—	36	—	Yes	Yes	—	—
17N/11W-27R1	North side of Pine Avenue, 2.0 miles east of Eastside Road.	R. E. Near	Drilled	Abandoned	75	—	12	—	Yes	Yes	—	—
17N/11W-28N1	North side of Pine Avenue, 0.2 mile east of Eastside Road.	J. Wipf	Dug	Domestic and Stock	12	—	36	—	Yes	Yes	—	—
17N/11W-28[illegible]1	North side of Pine Avenue, 0.5 mile west of Eastside Road.	E. Wipf	Dug	Domestic	18	—	36	—	Yes	Yes	—	Yes
17N/11W-2[illegible]F1	East side of Westside Road, 0.4 mile south of Rancho Rio Road.	D. Bonham	Dug	Domestic	20	—	48	—	Yes	Yes	—	Yes
17N/11W-29H1	West side of Eastside Road, 0.6 mile north of Pine Avenue.	F. Maquire	Dug	Domestic	21	—	36	—	Yes	Yes	—	—
17N/11W-29[illegible]1	0.3 mile east of Westside Road, 1.0 mile south of Rancho Rio Road.	G. Sullivan	Drilled	Domestic	37	—	8	—	—	Yes	—	Yes
17N/11W-32A1	West side of Eastside Road, south of Pine Avenue.	Diaz	Drilled	Domestic	37	—	12	—	Yes	Yes	—	—
17N/11W-32[illegible]1	East side of Westside Road, 1.6 miles north of junction with Eastside Road.	Harrison	Drilled	Domestic	100	—	8	—	—	Yes	—	—
17N/11W-32C2	East side of Westside Road, 1.5 miles north of junction with Eastside Road.	Harrison	Drilled	Domestic and Swimming Pool	100	—	12	—	—	Yes	—	—
17N/11W-32J1	West side of Eastside Road, 0.5 mile north of Burris Lane.	E. Foster	Dug	Domestic	12	—	36	—	Yes	Yes	—	—
17N/11W-32K1	East side of Westside Road, 0.8 mile north of junction with Eastside Road.	I. McGruder	Drilled	Domestic	48	—	10	—	Yes	Yes	—	Yes
17N/11W-32Q1	West side of Eastside Road, 500 feet north of Burris Lane extended, east side of East Fork Russian River.	R. Angel	Dug	Domestic	30	—	48	—	Yes	Yes	—	—

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Data available: Water analyses: Mineral	Data available: Water analyses: Bacterial
17N/11W-32Q2	West side of Eastside Road, 1,000 feet north of Burris Lane extended, east side of East Fork Russian River.	R. Ingel	Drilled	Domestic	70	—	12	—	Yes	Yes	—	—
17N/11W-33D1	South side of Pine Avenue, 1,000 feet east of Eastside Road.	W. Reiter	Drilled	Domestic and Irrigation	—	—	—	Yes	—	Yes	Yes	—
17N/11W-33N1	Northeast corner of Eastside Road and Burris Lane.	G. E. Marsh	Dug	Domestic	12	—	24	—	Yes	Yes	—	—
17N/11W-33Q1	North side of Burris Lane, 0.5 mile east of Eastside Road.	E. M. Velarde	Dug	Domestic and Stock	20	—	48	—	Yes	Yes	—	—
17N/11W-34N1	South side of Burris Lane, 1.2 miles east of Eastside Road.	G. W. Leask	Drilled	Domestic	—	—	—	Yes	—	Yes	Yes	—
17N/11W-34N2	South side of Burris Lane, 1.1 miles east of Eastside Road.	G. W. Leask	Dug	Domestic	30	—	48	—	—	Yes	—	—
17N/12W-12A1	East side of North Bush Road, 0.5 mile north of Bush Road.	E. E. Moody	Drilled	Domestic	42	—	12	—	Yes	Yes	—	—
17N/12W-12H1	East side of North Bush Road, 1,000 feet north of Bush Road.	F. Hughes	Drilled	Domestic	26	—	8	—	Yes	Yes	—	Yes
17N/12W-13B1	North side of Gibson Lane, 0.4 mile west of Rancho Rio Road.	H. Bufford	Dug	Domestic	26	—	30	—	Yes	Yes	Yes	—
17N/12W-13J1	West side of Rancho Rio Road, 0.3 mile north of Cross Road.	Dr. Styles	Drilled	Stock and Irrigation	150	—	10	—	—	Yes	—	—
17N/12W-13J2	West side of Rancho Rio Road, 0.5 mile north of Cross Road.	C. Eddie	Dug	Domestic	60	—	36	—	Yes	Yes	—	—
17N/12W-24H1	West side of Rancho Rio Road, 0.4 mile south of Cross Road.	C. Harvey	Dug	Domestic	20	—	36	—	Yes	Yes	—	—
		ROUND VALLEY										
22N/12W-4B1	100 feet east of Hansen Lane, 0.4 mile north of East Lane.	J. Perata	Drilled	Irrigation	—	—	—	Yes	Yes	Yes	—	—
22N/12W-5B1	0.5 mile north of East Lane, 1.6 miles east of Commercial Avenue.	F. Rhyme	Drilled	—	—	—	—	Yes	—	—	—	—
22N/12W-5F1	75 feet north of East Lane, 1.4 miles east of Commercial Avenue.	Dr. Welch	Drilled	Domestic and Stock	—	—	—	—	—	Yes	—	Yes
22N/12W-5L1	100 feet south of East Lane, 1.5 miles east of Commercial Avenue.	C. Swayze	Drilled	Domestic	—	—	—	—	—	—	Yes	—
22N/12W-5Q1	0.3 mile south of East Lane, 0.3 mile west of Adobe Lane.	C. H. Lengua	Drilled	Domestic	110	—	6	—	—	Yes	—	—
22N/12W-6E1	250 feet east of Commercial Avenue, 0.13 mile north of East Lane.	M. H. Hill	Drilled	Irrigation	206	160-190	12	—	Yes	Yes	—	—
22N/12W-6J3	75 feet south of East Lane, 0.95 mile east of Commercial Avenue.	E. H. McClure	Drilled	Domestic	60	—	6	—	—	Yes	—	—
22N/12W-6L2	300 feet south of East Lane, 0.4 mile east of Commercial Avenue.	W. B. Mocy	Drilled	Domestic and Irrigation	112	—	12	—	—	Yes	—	—

TABLE 1
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Water analyses: Mineral	Water analyses: Bacterial
22N/12W-7K4	0.75 mile east of Commercial Avenue on unnamed road, 1.0 mile south of East Lane.	H. Mackenzie	Drilled	Domestic	58	—	10	—	Yes	Yes	Yes	—
22N/12W-7L2	0.1 mile south of unnamed road, 0.4 mile on unnamed road from Commercial Avenue, 1.0 mile south of East Lane.	J. A. Langland	Drilled	Domestic	125	—	10	—	—	Yes	—	Yes
22N/12W-8F1	0.7 mile west of Adobe Lane in field, 0.9 mile south of East Lane.	H. Mackenzie	Drilled	Irrigation	73	—	8 and 10	—	—	Yes	—	—
22N/12W-8N1	0.9 mile north of Fairbanks Lane on Commercial Avenue, thence 1.2 miles east on unnamed road, thence north 0.3 mile.	J. D. Rohrbough	Drilled	Stock and Irrigation	187	—	10 and 12	—	—	Yes	Yes	—
22N/12W-9D1	0.65 mile south of East Lane on Adobe Lane, thence 0.15 mile east of road, on west side of Hill Creek.	G. Barrass	Drilled	Domestic	—	—	—	Yes	—	Yes	—	—
22N/12W-10M1	30 feet west of Hill Road, 1.1 miles south of East Lane.	L. Hemenway	Drilled	Domestic and Stock	100	—	12	—	—	Yes	—	Yes
22N/12W-16P1	North side of Fairbanks Lane extended, 0.5 mile east of Adobe Lane.	J. D. Rohrbough	Drilled	Stock	50	—	12 and 36	—	Yes	Yes	—	—
22N/12W-17F1	0.6 mile west of Adobe Lane, 0.5 mile north of Fairbanks Lane.	J. D. Rohrbough	Drilled	Stock	101	—	8	—	Yes	Yes	—	—
22N/12W-17P1	50 feet north of Fairbanks Lane, 0.65 mile west of Adobe Lane.	J. D. Rohrbough	Drilled	Stock	—	—	8	—	Yes	Yes	—	—
22N/12W-18D1	0.9 mile north of Fairbanks Lane on Commercial Avenue, thence 0.25 mile east on unnamed road, north side of road.	J. D. Rohrbough	Drilled	Abandoned	60	—	6	—	Yes	Yes	—	—
22N/12W-18N1	150 feet east of Commercial Avenue, 0.25 mile north of Fairbanks Lane.	H. Tuttle	Drilled	Irrigation and Stock	500	—	12	—	Yes	Yes	—	—
22N/12W-19F1	0.5 mile east of Dos Rios Road, 0.4 mile south of Fairbanks Lane, south of Turner Creek.	Diamond H Ranch	Drilled	Irrigation	—	—	—	Yes	Yes	Yes	—	—
22N/12W-19F3	0.45 mile east of Dos Rios Road, 0.3 mile south of Fairbanks Lane, south of Turner Creek.	Diamond H Ranch	Drilled	Irrigation	—	—	—	Yes	Yes	—	—	—
22N/12W-19G1	0.70 mile east of Dos Rios Road, 0.4 mile south of Fairbanks Lane, south of Turner Creek.	Diamond H. Ranch	Drilled	Irrigation	600	—	16	—	Yes	Yes	—	Yes
22N/12W-19M1	800 feet east of Dos Rios Road, 0.7 mile south of Fairbanks Lane, south of Turner Creek.	Diamond H Ranch	Drilled	Domestic Irrigation Stock	300	—	12	—	Yes	Yes	Yes	Yes
22N/12W-19N1	1,000 feet east of Dos Rios Road, 0.3 mile south of Fairbanks Lane.	Diamond H Ranch	Drilled	Abandoned	1,130	—	18	—	Yes	Yes	—	—
22N/12W-21A1	0.8 mile east of intersection of Fairbanks Lane and Adobe Lane, on north side of Turner Creek.	P. J. Rohrbough	Drilled	Domestic	—	—	—	Yes	Yes	Yes	Yes	Yes

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available				
								Log	Water levels	Construction survey	Water analyses	
											Mineral	Bacterial
22N/12W-21E1	800 feet east of Adobe Lane, 0.4 mile south of Fairbanks Lane, south of Turner Creek.	K. Colahan	Drilled	Domestic	52	—	6	—	Yes	Yes	—	Yes
22N/12W-21P1	0.4 mile east of Adobe Lane extended, 0.7 mile south of Fairbanks Lane extended.	J. Fisher	Drilled	Domestic	176	—	8	—	Yes	Yes	—	—
22N/13W-1C6	Southwest corner of intersection of Mill Road and Hornbrook Creek Road.	H. B. Hagen	Drilled	Domestic	—	—	—	Yes	Yes	Yes	—	Yes
22N/13W-1D1	East side of Smith Road, 800 feet south of Hornbrook Creek Road.	C. Tabor	Dug 32 Drilled 32-54	Domestic	54	—	48 Dug 8 Drilled	—	Yes	Yes	—	Yes
22N/13W-1E1	West side of Reservation Road, 900 feet north of Town Creek Road.	Covelo Ponderosa Pine Company	Drilled	Industrial	101	—	8	—	Yes	Yes	Yes	Yes
22N/13W-1F5	West side of Mill Road, 0.1 mile north of Town Creek Road.	D. Osborne	Drilled	Domestic and Irrigation	—	—	—	Yes	Yes	Yes	—	—
22N/13W-1F6	West side of Mill Road, 200 feet north of Town Creek Road.	Hearst	Drilled	Domestic	—	—	—	Yes	—	—	—	—
22N/13W-1H1	North side of East Lane, 800 feet west of Commercial Avenue.	Maxwell	Drilled	Irrigation	200	—	12	—	Yes	Yes	—	—
22N/13W-1J1	Southwest corner of Main and Howard Streets.	C. F. Gutcher	Drilled	Domestic	50	—	8	—	Yes	Yes	Yes	Yes
22N/13W-1J2	Southwest corner of Howard Street and Commercial Avenue.	G. Thrash	Drilled	Domestic	—	—	—	Yes	Yes	Yes	—	Yes
22N/13W-1K1	South side of Howard Street, 300 feet east of Mill Road.	Round Valley Union High School	Drilled	Domestic	—	—	6	—	Yes	Yes	—	Yes
22N/13W-1L2	West side of Mill Road between Howard Street and Town Creek Road.	Covelo Union School	Drilled	Domestic	200	—	12	—	Yes	Yes	—	Yes
22N/13W-2A3	700 feet west of Smith Road, 1,000 feet south of Hornbrook Creek Road.	W. Winters	Drilled	Irrigation	150	—	12	—	Yes	Yes	—	—
22N/13W-2L1	South side of Town Creek Road, 0.7 mile west of Smith Road on north side of Town Creek.	Jones	Drilled	Abandoned	60	—	8	—	Yes	Yes	—	—
22N/13W-12D1	0.4 mile north of Cemetery Lane, 0.9 mile west of Commercial Avenue.	Schultz	Drilled	Stock	280	—	12	—	—	Yes	—	—
22N/13W-12F1	North side of Cemetery Lane, 0.5 mile west of Commercial Avenue.	R. T. Hurt	Drilled	Domestic and Stock	60	—	6 or 8	—	—	Yes	—	—
22N/13W-12J1	West side of Commercial Avenue, 800 feet south of Cemetery Lane.	L. Hurt	Drilled	Domestic	70	—	6 or 8	—	—	Yes	—	Yes
22N/13W-12K1	South side of Cemetery Lane, 0.3 mile west of Commercial Avenue.	R. T. Hurt	Drilled	Irrigation	180	—	16	—	Yes	Yes	—	—
22N/13W-12K2	500 feet south of Cemetery Lane, 0.3 mile west of Commercial Avenue.	R. T. Hurt	Drilled	—	—	—	—	Yes	—	—	—	—
22N/13W-12K3	500 feet south of Cemetery Lane, 0.4 mile west of Commercial Avenue.	R. T. Hurt	Drilled	—	—	—	—	Yes	—	—	—	—

TABLE 1
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Water levels	Construction survey	Water analyses: Mineral	Bacterial
22N/13W-13A1	West side of Commercial Avenue, 0.6 mile south of Cemetery Lane.	E. F. Rohrbough	Drilled	Domestic	—	—	--	Yes	Yes	Yes	—	—
23N/12W-28N1	100 feet north of Charles Hill Road, 800 feet west of Hansen Lane.	Crawford Lumber Company	Drilled	Industrial and Domestic	164	—	8	—	—	Yes	Yes	—
23N/12W-29P2	900 feet north of Charles Hill Road, 1.0 miles west of Hansen Lane.	R. Goodwin	Drilled	Domestic	--	—	—	Yes	—	Yes	Yes	Yes
23N/12W-30E1	300 feet west of Commercial Avenue, 0.7 mile north of Charles Hill Road.	C. S. Foster	Drilled	Domestic	—	—	1.5	—	Yes	Yes	—	—
23N/12W-30R2	800 feet north of Charles Hill Road, 0.85 mile east of Commercial Avenue.	F. Vincent	Drilled	Domestic	180	—	6	—	—	Yes	—	Yes
23N/12W-31E1	700 feet east of Commercial Avenue, 0.3 mile south of Charles Hill Road.	W. Winters	Drilled	Irrigation and Stock	--	—	—	Yes	Yes	Yes	—	—
23N/12W-31L1	0.4 mile east of Commercial Avenue, 0.7 mile south of Charles Hill Road.	E. Brown	Drilled	Domestic	100	—	8	—	—	Yes	—	—
23N/12W-31M1	East side of Commercial Avenue, 0.7 mile south of Charles Hill Road.	State Division of Forestry	Drilled	Domestic	—	—	—	Yes	—	—	—	—
23N/12W-31N1	200 feet east of Commercial Avenue, 0.7 mile north of East Lane.	G. Graver	Drilled	Irrigation	200	—	12	Yes	—	Yes	Yes	—
23N/12W-31N2	100 feet east of Commercial Avenue, 0.7 mile north of East Lane.	G. Graver	Drilled	Domestic	—	—	—	Yes	—	—	—	—
23N/12W-32E1	0.35 mile south of Charles Hill Road, 1.05 miles east of Commercial Avenue.	J. Hurt	Driven	Domestic	42	—	1.25	—	—	Yes	—	Yes
23N/12W-33L1	500 feet west of Hansen Lane, 0.9 mile north of East Lane.	E. Bauer	Drilled	Domestic Irrigation Stock	—	—	—	Yes	—	Yes	Yes	Yes
23N/13W-24H1	50 feet west of Commercial Avenue, 1.7 miles north of Charles Hill Road.	Stillwell	Drilled	Domestic and Stock	—	—	—	Yes	Yes	Yes	—	—
23N/13W-25A1	300 feet west of Commercial Avenue, 0.8 mile north of Charles Hill Road.	W. P. Rome	Driven	Domestic	70	—	1.25	—	Yes	Yes	Yes	Yes
23N/13W-25J2	800 feet west of Commercial Avenue, 0.3 mile north of Charles Hill Road.	J. C. Walters	Driven	Domestic and Stock	50	—	1.25	—	Yes	Yes	—	—
23N/13W-25P1	600 feet east of Reservation Road, 900 feet north of Charles Hill Road.	W. V. Clarke	Drilled	Domestic Irrigation Stock	102	47-102	10	—	Yes	Yes	—	—
23N/13W-26Q2	500 feet north of Poonkinny Ridge Road, 0.7 mile west of Reservation Road.	M. Major	Driven	Domestic	60	—	2	—	—	Yes	—	Yes

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WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Data available: Water analyses: Mineral	Data available: Water analyses: Bacterial
23N/13W-26R1	North side of Poonkinney Ridge Road, 0.4 mile west of Reservation Road.	L. Dunlap	Drilled	Domestic	40	—	—	—	Yes	Yes	—	—
23N/13W-35C1	South side of Poonkinney Ridge Road, 0.8 mile west of Reservation Road.	J. McCandles	Drilled	Domestic	60	—	8	—	Yes	Yes	—	—
23N/13W-35H2	0.3 mile west of Reservation Road, 0.6 mile north of Hornbrook Creek Road.	L. O'Farrel	Drilled	Domestic and Stock	30	—	8	—	—	Yes	—	—
23N/13W-35Q1	North side of Hornbrook Creek Road, 0.7 mile west of Reservation Road.	W. R. Card	Dug and Drilled	Domestic	—	—	—	Yes	Yes	Yes	Yes	—
23N/13W-36A1	West side of Commercial Avenue, 0.2 mile south of Charles Hill Road.	Reservation School	Drilled	Domestic	—	—	—	Yes	Yes	Yes	—	Yes
23N/13W-36C2	East side of Reservation Road, 0.2 mile south of Charles Hill Road, on south side of Mill Creek.	C. O'Farrel	Drilled	Irrigation	80	—	12	—	Yes	Yes	—	—
23N/13W-36J1	West side of Commercial Avenue, 0.5 mile south of Charles Hill Road.	J. D. Albonico	Drilled	Domestic	135	—	10 or 12	—	Yes	Yes	—	—
23N/13W-36N2	Northwest corner of intersection of Reservation Road and Hornbrook Creek Road.	R. Brown	Driven	Domestic	--	—	—	Yes	—	Yes	—	Yes
23N/13W-36P2	North side of Hornbrook Creek Road, 700 feet east of Reservation Road.	C. A. Gray	Drilled	Irrigation	128	—	12	—	Yes	Yes	—	—
23N/13W-36R1	West side of Commercial Avenue, 0.7 mile north of East Lane.	G. Bauer	Driven	Stock	20	—	2.25	—	—	Yes	—	—
		UKIAH VALLEY										
14N/12W-3F1	South side Hop Road, 0.7 mile west of East River Road intersection, 2.0 miles south of Talmage.	L. Arnold	Drilled	Domestic	—	—	12	—	Yes	Yes	—	Yes
14N/12W-3J1	0.2 mile west of East River Road, 2.3 miles south of Talmage.	F. E. Tenter	Drilled	Irrigation	56	—	24	—	Yes	Yes	—	—
14N/12W-3Q1	0.2 mile west of East River Road, 2.6 miles south of Talmage.	McGarvey	Drilled	Domestic	72	—	16	—	Yes	Yes	—	Yes
14N/12W-4E1	West side of U.S. Highway 101, 0.3 mile south of Boonville Ukiah Cutoff, north side of Robertson Creek.	H. Cnomiya	Drilled	Domestic and Irrigation	—	—	—	Yes	—	Yes	—	Yes
14N/12W-4K1	East side of U.S. Highway 101, 0.7 mile south of Boonville Ukiah Cutoff, south of Robertson Creek.	C. J. Cox	Dug	Domestic	20	—	36	—	Yes	Yes	—	Yes
14N/12W-5K1	South side of Boonville Ukiah Cutoff, 0.7 mile west of U.S. Highway 101.	Gilley	Drilled	Domestic and Irrigation	94	—	6	—	Yes	Yes	Yes	Yes
14N/12W-7A1	South side of Boonville Ukiah Cutoff, 1.7 miles west of U.S. Highway 101, north side of Robertson Creek.	Cox	Dug	Domestic	25	—	24	—	Yes	Yes	—	—
14N/12W-9H1	East side of U.S. Highway 101, 1.5 miles south of Boonville Ukiah Cutoff.	G. Butler	Dug	Domestic	—	—	36	—	Yes	Yes	—	Yes

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WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available				
								Log	Water levels	Construction survey	Water analyses: Mineral	Water analyses: Bacterial
14N/12W-11N1	300 feet west of East River Road, 3.8 miles south of Talmage.	L. Johnson	Dug	Domestic	30	—	36	—	Yes	Yes	Yes	—
14N/12W-14G1	East side of East River Road, 4.7 miles south of Talmage.	Stevens Ranch	Drilled	Domestic	--	—	—	Yes	Yes	Yes	—	—
14N/12W-16A1	0.2 mile west of U.S. Highway 101, 2.0 miles south of Boonville Ukiah Cutoff.	Romer	Drilled	Domestic	50	—	8	—	Yes	Yes	Yes	—
14N/12W-23A1	300 feet west of East River Road, 4.9 miles south of Talmage.	F. H. Swisher	Drilled	Domestic	--	—	--	Yes	Yes	Yes	—	—
14N/12W-25G1	West side of East River Road, 25 feet east of Russian River, 6.4 miles south of Talmage.	J. R. Lowe	Dug	Domestic	26	—	24	—	—	Yes	—	Yes
14N/12W-25R1	700 feet west of East River Road, 7.0 miles south of Talmage.	E. V. Ruddick	Drilled	Domestic	40	—	12	—	Yes	Yes	Yes	—
14N/12W-26K1	West side of U.S. Highway 101, north side of McNab Creek, 5.0 miles south of Boonville Ukiah Cutoff.	J. H. Penner	Drilled	Domestic	300	—	8	—	Yes	Yes	Yes	—
14N/12W-28G1	North side of McNab Creek Road, 2.0 miles west of U.S. Highway 101.	Chamber and Scott	Drilled	Stock	50	—	12	—	Yes	Yes	—	—
15N/12W-4D1	West side of East Valley Road, 2.5 miles north of Perkins Street Bridge, east side of Russian River.	R. Garbocci	Dug	Domestic	14	—	24x24	—	Yes	Yes	—	—
15N/12W-4E1	West side of East Valley Road, 2.3 miles north of Perkins Street Bridge.	Valette	Dug	Domestic	—	—	36x36	—	Yes	Yes	--	—
15N/12W-5C1	West side of U.S. Highway 101, 0.1 mile south of The Forks.	E. Cleveland	Drilled	Domestic	70	--	10	—	—	Yes	—	Yes
15N/12W-5K1	West side of Northwestern Pacific Railroad, north side of Hensley Creek, 0.4 mile south of The Forks.	H. E. Castell	Drilled	Domestic and Industrial	65	--	10	--	—	Yes	—	--
15N/12W-5P1	East side of U.S. Highway 101, 0.5 mile north of Orrs Springs Ukiah Road.	Bordens Dairy	Drilled	Domestic and Industrial	—	—	--	Yes	Yes	Yes	—	Yes
15N/12W-6A1	North side of Hensley Creek, 0.5 mile west of U.S. Highway 101 at The Forks.	R. Odell	Dug	Domestic	22	—	72	--	Yes	Yes	—	—
15N/12W-7B1	North side of Orrs Springs Ukiah Road, 0.3 mile west of U. S. Highway 101.	United States Government	Drilled	Domestic	—	--	8	--	Yes	Yes	—	—
15N/12W-7P1	0.4 mile north of Low Gap Road, 0.6 mile west of U.S. Highway 101.	Martin	Dug	Domestic	33	--	36	—	Yes	Yes	—	—
15N/12W-8D1	North side of Orrs Springs Ukiah Road, 0.2 mile west of U.S. Highway 101, on south side of Ackerman Creek.	Mayfield	Drilled	Domestic	165	—	6	—	—	Yes	Yes	—
15N/12W-8H1	At Masonite Corporation Plant, on east side of U.S. Highway 101, opposite Orrs Springs Ukiah Road.	Masonite Corporation Well #1	Drilled	Domestic and Industrial	—	--	—	Yes	—	Yes	—	—
15N/12W-8J1	At Masonite Corporation Plant, on east side of U.S. Highway 101, opposite Orrs Springs Ukiah Road.	Masonite Corporation Well #2	Drilled	Domestic and Industrial	102	18-88	20	—	—	Yes	—	—

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Data available: Water analyses: Mineral	Data available: Water analyses: Bacterial
15N/12W-8L1	East side of U.S. Highway 101, 0.3 mile south of Orrs Springs Ukiah Road.	Bogner	Drilled	Domestic	63	—	12	—	—	Yes	—	—
15N/12W-8N1	West side of U.S. Highway 101, 0.6 mile north of Low Gap Road.	Cohen	Drilled	Domestic	--	—	--	Yes	—	Yes	--	Yes
15N/12W-8N2	West side of U.S. Highway 101, 0.7 mile north of Low Gap Road.	A. C. Cuffgard	Dug	Domestic	6	—	36	—	—	Yes	—	—
15N/12W-9C1	West side of East Valley Road, 1.7 miles north of Perkins Street Bridge.	E. Pratti	Dug	Domestic	—	—	36	—	Yes	Yes	—	Yes
15N/12W-14C1	At Vichy Springs Resort, 1,000 feet east of Vichy Springs Road, 2.5 miles east of Perkins Street Bridge.	Vichy Springs Resort	Spring	Mineral baths	—	—	—	--	--	--	Yes	—
15N/12W-14D1	At Vichy Springs Resort, south side of Vichy Springs Road, 2.3 miles east of Perkins Street Bridge.	Vichy Springs Resort	Drilled	Domestic	22	—	8	—	Yes	Yes	—	--
15N/12W-15F1	North side of Vichy Springs Road, 1.4 miles east of Perkins Street Bridge.	Garbocci	Dug	Domestic	--	—	--	Yes	Yes	Yes	--	—
15N/12W-16D1	West side of Russian River, 1.0 mile north of Perkins Street.	M. C. Barnes	Drilled	Domestic	—	—	8	—	Yes	Yes	--	—
15N/12W-16D2	West side of Russian River, 0.8 mile north of Perkins Street.	M. C. Barnes	Dug	Irrigation	24	—	42	—	Yes	Yes	—	—
15N/12W-16E1	West side Russian River, 0.7 mile north of Perkins Street.	City of Ukiah Well Number 1	Dug	Municipal	22	--	72 x 72	--	Yes	Yes	Yes	--
15N/12W-16E2	West side Russian River, 0.6 mile north of Perkins Street.	City of Ukiah Well Number 2	Dug	Municipal	34	—	84	—	Yes	Yes	—	--
15N/12W-16F1	1,000 feet west of East Valley Road, 0.7 mile north of Perkins Street Bridge.	Jones	Dug	Domestic	22	--	--	—	Yes	Yes	—	--
15N/12W-16Q1	South side of Perkins Street, 0.2 mile west of Perkins Street Bridge.	City of Ukiah Well Number 3	Dug	Municipal	37	--	84	--	Yes	Yes	Yes	--
15N/12W-17D1	West side U.S. Highway 101, 0.5 mile north of Low Gap Road.	Davis Appliances	Drilled	Domestic	—	—	—	Yes	—	Yes	—	Yes
15N/12W-21M1	0.5 mile north of Talmage Road, 0.5 mile east of U.S. Highway 101.	McCarty Brothers	Dug	Domestic and Irrigation	46	—	24	--	Yes	Yes	—	--
15N/12W-21P1	1,000 feet north of Talmage Road, 0.4 mile west of Talmage Bridge.	G. E. Cook	Dug	Domestic	25	--	36	—	--	Yes	—	Yes
15N/12W-22D1	East side of East Valley Road, 0.5 mile south of Perkins Street Bridge.	Regina Water Company Well Number 1	Dug	Municipal	22	—	84	--	Yes	Yes	Yes	—
15N/12W-22D2	1,000 feet east of East Valley Road, 0.5 mile south of Perkins Street Bridge.	F. Regina	Spring	—	—	—	—	--	--	--	Yes	—
15N/12W-22Q1	North side of East Valley Road, 0.6 mile northwest of Talmage.	Ceccarelli	Drilled	Domestic	—	—	—	Yes	—	Yes	--	--
15N/12W-22R1	West side of East Valley Road, 0.4 mile north of Talmage.	E. Bartolomei	Drilled	Domestic	80	—	—	—	—	Yes	—	—

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Data available: Water analyses: Mineral	Data available: Water analyses: Bacterial
15N/12W-22R2	1,000 feet east of East Valley Road, 0.3 mile north of Talmage.	—	Drilled	Domestic	96	—	12	—	—	Yes	—	Yes
15N/12W-26A1	North side of Middle Creek Road, 1.1 miles east of East Valley Road, on south side of North Fork Middle Creek.	Herring	Dug	Domestic	17	—	36	—	Yes	Yes	—	—
15N/12W-26L1	South side Middle Creek Road, 0.4 mile east of East Valley Road.	J. A. Laviletta	Drilled	Domestic	—	—	—	Yes	Yes	Yes	—	—
15N/12W-27K1	0.2 mile west of East River Road, 0.4 mile south of Talmage Road.	State of California	Dug	Irrigation	—	—	72	—	Yes	—	Yes	—
15N/12W-27N1	0.55 mile south of Talmage on East Valley Road, thence 0.9 mile west on unnamed road.	State of California	Drilled	Irrigation	90	—	14	—	—	Yes	—	—
15N/12W-28R1	0.2 mile east of Talmage Road Bridge, thence 0.6 mile south on Hop Road.	L. Hildreth	Dug	Domestic	30	—	36	—	Yes	Yes	—	Yes
15N/12W-32A1	East side of U.S. Highway 101, 1.1 miles south of Talmage Road.	N. T. Moschetti	Drilled	Irrigation	100	—	10	—	—	Yes	—	—
15N/12W-32Q1	0.3 mile west of U.S. Highway 101, 1.8 miles south of Talmage Road.	Gobalet	Drilled	Domestic	65	—	12	—	—	Yes	—	Yes
15N/12W-33E1	1,000 feet east of U.S. Highway 101, 1.1 miles south of Talmage Road.	H. D. Roberts	Drilled	Irrigation	25	—	6	—	Yes	Yes	—	—
15N/12W-33F1	0.4 mile east of U.S. Highway 101, 1.4 miles south of Talmage Road.	Willow Water District, Well #1	Drilled	Municipal	97	--	12	—	—	Yes	—	—
15N/12W-33F2	0.5 mile east of U.S. Highway 101, 1.4 miles south of Talmage Road.	Willow Water District, Well #2	Drilled	Municipal	--	—	—	Yes	—	Yes	—	—
15N/12W-34E1	0.2 mile east of Talmage Road Bridge, thence 1.2 miles south on Hop Road.	E. Puddick	Dug	Irrigation	24	—	24	—	Yes	Yes	—	—
15N/12W-35D1	West side of East Valley Road, 0.9 mile south of Talmage.	D. Proggi	Drilled	Domestic	60	—	12	—	Yes	Yes	Yes	Yes
15N/12W-35M1	800 feet west of East Valley Road, 1.4 miles south of Talmage.	C. F. Wegner	Drilled	Irrigation	—	—	—	Yes	Yes	Yes	—	—
16N/12W-3M1	North side of Road D, 1.2 miles east of Redwood Valley Road.	C. Locatelli	Drilled	Domestic	124	—	8	—	Yes	Yes	—	Yes
16N/12W-4B1	0.3 mile north of Road E, 0.7 mile east of Redwood Valley Road.	M. Maki	Dug	Domestic	32	—	42	—	Yes	Yes	—	—
16N/12W-4F1	North side of Road E, 0.5 mile east of Redwood Valley Road.	F. J. Ebbert	Dug	Domestic	30	—	36	—	—	Yes	—	—
16N/12W-4M1	East side of Redwood Valley Road, 2.5 miles north of Calpella	R. Arnold	Dug	Domestic	58	—	48	—	Yes	Yes	—	—
16N/12W-4P1	South side of Road D, 0.3 mile east of Redwood Valley Road.	J. Witherell	Dug	Domestic	12	—	42	—	Yes	Yes	—	—
16N/12W-4R1	South side of Road D, 0.8 mile east of Redwood Valley Road.	G. J. Eisert	Dug	Domestic	36	—	48	—	Yes	Yes	—	—
16N/12W-5D1	West side of West Road, 0.3 mile north of Northwestern Pacific Railroad Crossing.	F. Brown	Dug	Domestic	25	--	64	—	Yes	Yes	Yes	Yes
16N/12W-5M1	West side of West Road, 0.2 mile south of Northwestern Pacific Railroad Crossing.	Hanson Lumber Company	Drilled	Industrial	72	—	8	—	—	Yes	—	—

TABLE 1
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available				
								Log	Water levels	Construction survey	Water analyses	
											Mineral	Bacteriol
16N/12W-6F1	West side of Laughlin Way, 0.3 mile north of U.S. Highway 101.	E. Elliott	Dug	Domestic	30	—	36	—	—	Yes	—	—
16N/12W-6R1	North side of U.S. Highway 101, 2.7 miles northwest of Calpella.	T. Hinds	Drilled	Domestic	58	—	12	—	Yes	Yes	—	—
16N/12W-7A1	North side of U.S. Highway 101, 2.5 miles northwest of Calpella.	Forbes	Dug	Domestic	32	—	30	—	—	Yes	—	Yes
16N/12W-7J1	West side of Uva Drive, 1.2 miles northwest of Calpella.	M. Ranbeau	Dug	Domestic	18	—	36	—	—	Yes	—	Yes
16N/12W-7L1	North side of Eldridge Creek Road, 0.6 mile west of Uva Drive.	E. Jacobsen	Drilled	Domestic	24	—	6	—	—	Yes	Yes	—
16N/12W-8A1	South side of School Way, 0.4 mile west of Redwood Valley Road, 2.1 miles north of Calpella.	W. Opas	Drilled	Domestic	—	—	—	Yes	—	Yes	—	Yes
16N/12W-8C1	South side of School Way, 1.0 mila west of Redwood Valley Road.	L. Bott	Drilled	Domestic	108	—	8	—	—	Yes	—	—
16N/12W-8R1	East side of U.S. Highway 101, 0.4 mile north of Uva Drive.	E. R. Williams	Drilled	Domestic	30	—	12	—	—	Yes	—	—
16N/12W-9J1	South side of Road B, 0.6 mile east of Redwood Valley Road.	M. Gerhart	Dug	Domestic	22	—	36 x 36	—	Yes	Yes	—	—
16N/12W-9L1	Southeast corner of intersection of Road B and Redwood Valley Road.	O. J. Billehus	Dug	Domestic	25	—	48 x 48	—	Yes	Yes	—	—
16N/12W-9Q1	1,000 feet east of Redwood Valley Road, 0.4 mile north of Road A.	Pacific Gas and Electric Company	Drilled	Industrial and Domestic	—	—	—	Yes	—	Yes	Yes	Yes
16N/12W-10L1	South side of Road B, 1.3 miles east of Redwood Valley Road.	G. White	Dug	Domestic	40	—	48	—	—	Yes	—	—
16N/12W-15H1	East side of Road B, 0.2 mile north of intersection of Road A with Road B.	E. George	Dug	Domestic	—	—	36	—	Yes	Yes	—	—
16N/12W-15P1	West side of unnamed Road, 0.4 mile north of Calpella Cutoff, 0.6 mile west of State Highway 20.	S. W. Doane	Drilled	Domestic	—	—	8	—	—	Yes	—	Yes
16N/12W-16K1	East side of Old River Road, 0.25 mile south of Road A.	Judge Held	Drilled	Domestic	—	—	—	Yes	—	Yes	—	—
16N/12W-16P1	West side of Redwood Valley Road, 700 feet north of U.S. Highway 101.	K. Masters	Dug	Domestic	20	—	36	—	Yes	Yes	—	Yee
16N/12W-17H1	West of U.S. Highway 101, 0.9 mile north of Calpella Post Office.	F. C. Bull	Drilled	Domestic	110	—	8	—	Yes	Yes	—	—
16N/12W-17M1	0.9 mile west of U.S. Highway 101, 0.5 mile north of Calpella Post Office.	B. Newell	Dug	Domestic	55	—	36	—	Yes	Yes	—	—
16N/12W-17R1	0.3 mile west of U.S. Highway 101, 0.2 mile north of Calpella Post Office.	G. Venturi	Dug	Domestic	100	—	48	—	—	Yes	—	Yes
16N/12W-20R1	0.3 mile west of U.S. Highway 101, 0.8 mile south of Calpella Post Office.	B. Viarinyo	Dug	Domestic	65	—	36	—	—	Yes	—	Yes
16N/12W-21C1	West side of Old River Road, 500 feet north of Calpella cutoff.	F. Carpen	Dug	Domestic	15	—	48	—	—	Yes	—	—
16N/12W-21C2	East side of U.S. Highway 101, 500 feet south of Calpella Post Office.	B. Hooper	Drilled	Domestic	60	—	6	—	—	Yes	—	—

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WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Data available: Water analyses: Mineral	Data available: Water analyses: Bacterial
16N/12W-21E1	East side of U.S. Highway 101, 0.3 mile south of Calpella Post Office.	J. Coreia	Drilled	Domestic	35	—	6	—	—	Yes	—	—
16N/12W-21P1	West side of Old River Road, 0.6 mile south of Calpella Cutoff.	V. R. Sherwood	Dug	Domestic	42	—	36	—	Yes	Yes	—	—
16N/12W-22H1	West side of State Highway 20, 0.2 mile south of Calpella Cutoff.	R. Aguilar	Drilled	Domestic	48	—	8	—	Yes	Yes	Yes	Yes
16N/12W-22M1	0.3 mile south of Calpella Cutoff, 0.7 mile east of Old River Road.	C. W. Williams	Drilled	Domestic	--	—	—	Yes	—	Yes	—	—
16N/12W-22Q1	West side of State Highway 20, 0.9 mile south of Calpella Cutoff.	M. A. Christy	Dug	Domestic	17	—	36	—	Yes	Yes	—	—
16N/12W-26D1	0.5 mile east of State Highway 20, 1.0 mile south of Calpella Cutoff.	Hooper	Drilled	Irrigation	—	—	—	Yes	Yes	Yes	Yes	—
16N/12W-27C1	West side of State Highway 20, 1.4 miles south of Calpella Cutoff.	L. Chandler	Dug	Domestic	15	—	36	—	—	Yes	--	—
16N/12W-28C1	East side of Old River Road, 1.6 miles north of State Highway 20.	J. Tolin	Dug	Domestic	22	—	66	—	Yes	Yes	—	—
16N/12W-28P1	East side of U.S. Highway 101, 1.2 miles north of The Forks.	E. Rusco	Dug	Domestic	14	—	36	—	Yes	Yes	—	—
16N/12W-28Q1	East side of Old River Road, 1.1 miles north of State Highway 20.	D. Reha	Dug	Domestic	25	—	48	—	Yes	Yes	—	—
16N/12W-33G1	West side of Old River Road, 0.4 mile north of State Highway 20.	Soloman	Dug	Domestic	19	—	48	—	—	Yes	—	—
16N/12W-33M1	West side of U.S. Highway 101, 700 feet north of The Forks.	R. Cinquini	Dug	Domestic	20	—	36	—	Yes	Yes	—	—
16N/12W-33R1	South side of State Highway 20, 800 feet east of Old River Road.	G. M. Portlock	Drilled	Domestic	72	—	12	—	Yes	Yes	—	—
16N/12W-34F1	East side of State Highway 20, 0.76 mile northeast of Old River Road.	G. Aggi	Dug	Domestic	27	—	72	—	Yes	Yes	—	Yes
16N/12W-34Q1	South side of Coyote Valley Road, 0.6 mile east of State Highway 20.	H. Busch	Dug	Domestic	24	—	36	—	Yes	Yes	—	—
16N/13W-1J1	900 feet south of U.S. Highway 101, 0.7 mile west of Laughlin Way.	D. Baldwin	Dug	Irrigation	35	—	48	—	Yes	Yes	Yes	—
16N/13W-1L1	0.4 mile south of U.S. Highway 101, 1.2 miles west of Laughlin Way.	J. Bragg	Drilled	Domestic	29	—	2	—	—	Yes	—	—
17N/12W-18A1	West side of Tomki Road, 1.4 miles north of Redwood Valley Road.	J. Nelson	Drilled	Domestic	57	—	8	—	Yes	Yes	Yes	—
17N/12W-20R1	East side of Redwood Valley Road, 0.6 mile southwest of Tomki Road.	N. Tucker	Drilled	Domestic	—	—	8	—	Yes	Yes	—	Yes
17N/12W-28M1	East side of Redwood Valley Road, 500 feet north of Road L.	H. Mathews	Dug	Domestic	32	—	48	—	Yes	Yes	Yes	Yes
17N/12W-28P1	South side of Road L, 0.4 mile east of Redwood Valley Road.	A. Cantaroni	Dug	Domestic	32	—	48	—	Yes	Yes	—	—
17N/12W-29C1	East side of West Road, 0.5 mile south of Redwood Valley Road intersection with Tomki Road.	J. Risetti	Dug	Domestic	32	—	60	—	Yes	Yes	—	—

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WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available				
								Log	Water levels	Construction survey	Water analyses	
											Mineral	Bacterial
17N/12W-29E1	West side of West Road, 0.75 mile south of Redwood Valley Road intersection with Tomki Road.	Hoag	Dug	Domestic	—	—	48	—	Yes	Yes	—	—
17N/12W-29H1	West side of Redwood Valley Road, 0.5 mile north of Road L.	J. Bringle	Dug	Domestic	40	—	24 x 24	—	Yes	Yes	—	—
17N/12W-31P1	Northwest corner of intersection of School Way and Laughlin Way	E. L. Wigger	Drilled	Domestic	55	—	8	—	—	Yes	—	—
17N/12W-32C1	East side of West Road, 0.6 mile north of School Way.	H. Carr	Dug	Domestic	14	—	48	—	Yes	Yes	—	—
17N/12W-32J1	700 feet west of Redwood Valley Road, 500 feet north of Road I.	R. Harmon	Dug	Domestic	20	—	42	—	Yes	Yes	—	—
17N/12W-32M1	Northwest corner of intersection of School Way and West Road.	H. Gray	Dug	Domestic	—	—	36	—	Yes	Yes	—	—
17N/12W-33J1	North side of Road I, 0.8 mile east of Redwood Valley Road.	R. Reed	Dug	Domestic	32	—	60	—	Yes	Yes	—	—
17N/12W-33L1	South side of Road I, 0.3 mile east of Redwood Valley Road.	D. Berry	Drilled	Domestic	42	—	12	—	—	Yes	—	—
17N/12W-34N1	East side of Road I, 1.2 miles east of Redwood Valley Road.	C. Alavo	Drilled	Domestic	54	—	8	—	—	Yes	—	Yes
	FORT BRAGG TERRACE AND CONTIGUOUS AREAS											
16N/17W-6A1	East side of State Highway 1, 1.3 miles south of Comptche Road.	F. Langton	Dug	Domestic	28	—	48	—	Yes	Yes	—	Yes
16N/17W-17F1	West side of State Highway 1, 2.1 miles north of Albion River.	A. Robinson	Dug	Domestic	39	—	48	—	Yes	Yes	—	Yes
16N/17W-17Q1	West side of State Highway 1, 1.6 miles north of Albion River.	Kiesling	Dug	Domestic	25	—	48	—	Yes	Yes	—	—
16N/17W-28D1	East side of State Highway 1, 500 feet north of Albion River.	V. Hawkins	Dug and Drilled	Domestic	—	—	—	—	Yes	Yes	—	—
17N/16W-28F1	North side Mendocino Lumber Company Ranch Road, 9.5 miles east of Mendocino.	Mendocino Lumber Company	Spring	None	—	—	—	—	—	—	Yes	—
17N/17W-6C1	South side of Jug Handle Creek, 0.9 mile northeast of Caspar.	J. Pank	Dug	Domestic	17	—	48	—	Yes	Yes	—	—
17N/17W-7N1	0.4 mile east of State Highway 1, 1.6 miles south of Caspar.	A. Oates	Dug	Domestic	22	—	60	—	—	Yes	—	—
17N/17W-19D1	West side of State Highway 1, 1,000 feet south of Russian Gulch.	J. Helfer	Dug	Domestic	22	—	72	—	Yes	Yes	—	Yes
17N/17W-19P1	West side of State Highway 1, 0.7 mile north of Mendocino.	Helfer	Dug	Domestic	14	—	48	—	Yes	Yes	Yes	Yes
17N/17W-30F1	East side of State Highway 1, 0.2 mile north of Mendocino.	D. Reese	Dug	Domestic	60	—	48	—	Yes	Yes	—	Yes
17N/17W-30K1	East side of State Highway 1 in Mendocino, behind Bedell's Hotel.	Bedell	Dug	Domestic	—	—	48	—	—	Yes	—	—
17N/17W-30L1	South side of Third Street, 500 feet west of State Highway 1.	R. Doolittle	Dug	Domestic	17	—	48	—	—	Yes	—	Yes
17N/17W-30M1	North side of Second Street, 0.3 mile west of State Highway 1.	R. W. Preston	Dug	Domestic	47	—	48	—	Yes	Yes	—	—
17N/17W-31H1	East side of State Highway 1, 0.5 mile south of Big River Bridge.	B. C. Ranch	Dug	Domestic	14	—	48	—	—	Yes	—	—

TABLE 1
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Water analyses: Mineral	Water analyses: Bacterial
17N/17W-31K1	0.2 mile west of State Highway 1, 0.9 mile south of Big River Bridge.	Chapman	Spring	Domestic	—	—	—	—	—	—	Yes	—
17N/17W-31R1	1,000 feet east of State Highway 1, 1.2 miles south of Big River Bridge.	L. Harvey	Dug	Domestic	23	—	48	—	—	Yes	—	Yes
17N/18W-1J1	0.2 mile east of State Highway 1 at Caspar, beneath water tower.	Caspar Lumber Company	Dug	Municipal	20	—	48	—	Yes	Yes	—	Yes
17N/18W-1K1	East side of State Highway 1, 0.2 mile north of Caspar	Caspar Hotel	Dug	Domestic	20	—	36	—	Yes	Yes	—	Yes
17N/18W-12J1	East side of State Highway 1, 1.0 mile south of Caspar Creek.	G. Berglund	Dug	Domestic	—	—	48	—	—	Yes	—	Yes
17N/18W-12M1	0.5 mile west of State Highway 1, 1.0 mile south of Caspar Creek.	United States Coast Guard	Driven	Domestic	14	—	2	—	—	Yes	—	—
17N/18W-13B1	West side of State Highway 1, 1.3 miles south of Caspar Creek.	R. E. Luhisen	Dug	Domestic	30	—	48	—	Yes	Yes	—	—
17N/18W-13C1	0.3 mile west of State Highway 1, 1.3 miles south of Caspar Creek.	Hollingsworth	Drilled	Domestic	—	—	—	Yes	—	Yes	—	Yes
17N/18W-13R1	0.2 mile west of State Highway 1, 0.4 mile north of Russian Gulch.	D. W. Wilkie	Dug	Domestic	22	—	48	—	Yes	Yes	—	—
18N/17W-5K1	East side of Pudding Creek Road, 1.5 miles east of State Highway 1.	H. A. Pajoki	Dug	Domestic	20	—	48	—	Yes	Yes	—	—
18N/17W-6K1	South side of Pudding Creek Road, 0.6 mile east of State Highway 1.	M. Pedsoni	Dug	Domestic	22	—	36	—	Yes	Yes	—	Yes
18N/17W-7B1	North side of Oak Street, 0.5 mile east of State Highway 1.	Colombi	Dug	Domestic	17	—	36	—	Yes	Yes	—	—
18N/17W-7J1	North side of Chestnut Street, 0.8 mile east of State Highway 1.	—	Dug	Domestic	22	—	48	—	Yes	Yes	—	Yes
18N/17W-8C1	North side of Oak Street, 1.4 miles east of State Highway 1, at radio tower.	Radio Station	Drilled	Domestic	20	—	8	—	—	Yes	—	Yes
18N/17W-18M1	Northeast corner of State Highway 1, and Fort Bragg Willits Road.	F. Dodson	Dug	Domestic	22	—	48	—	Yes	Yes	—	—
18N/17W-20B1	South side of Fort Bragg Willits Road, 1.5 miles east of State Highway 1.	J. H. Hackett	Dug	Domestic	19	—	36	—	—	Yes	—	—
18N/17W-30D1	0.3 mile east of old State Highway 1, 1.5 miles south of Fort Bragg Willits Road, on east side of new State Highway 1.	Fort Bragg Dairy	Dug	Domestic	17	—	48	—	Yes	Yes	—	Yes
18N/18W-24J1	On west side of old State Highway 1, 0.8 mile south of Fort Bragg Willits Road.	E. O. Boardman	Dug	Domestic	11	—	48	—	Yes	Yes	—	Yes
18N/18W-25Q1	East side of State Highway 1, 0.9 mile north of Jug Handle Creek.	A. T. Massey	Dug	Domestic	18	—	48	—	Yes	Yes	—	Yes
18N/18W-36G1	East side of State Highway 1, 0.5 mile north of Jug Handle Creek.	—	Dug	Domestic	16	—	36	—	—	Yes	—	—
19N/17W-4P1	West side of State Highway 1, 1.0 mile south of Ten Mile River.	M. W. Wilsey	Dug	Domestic	16	—	60	—	Yes	Yes	—	Yes

TABLE 1
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available				
								Log	Water levels	Construction survey	Water analyses	
											Mineral	Bacterial
19N/17W-9G1	East side of State Highway 1, 1.5 miles south of Ten Mile River.	Brunamin	Dug	Domestic	20	—	36	—	—	Yes	—	—
19N/17W-9L1	West side of State Highway 1, 1.8 miles south of Ten Mile River.	Brooks	Dug	Domestic	12	—	120	—	Yes	Yes	—	Yes
19N/17W-15N1	South side of Little Valley Road, 1.0 mile east of State Highway 1.	L. E. Traubold	—	—	—	—	—	—	—	—	Yes	—
19N/17W-19R1	West side of Ranger Station, in MacKerricher State Park.	State Division of Beaches and Parks	Auger Test Hole	—	12	—	8	—	—	—	Yes	—
19N/17W-19R2	North of equipment yard in MacKerricher State Park.	State Division of Beaches and Parks	Drilled	—	70	—	12	—	Yes	Yes	Yes	Yes
19N/17W-20F1	East side of State Highway 1, 0.6 mile north of MacKerricher State Park.	G. Sarkannen	Dug	Domestic	10	—	48	—	Yes	Yes	—	Yes
19N/17W-20L1	West side of State Highway 1, 0.5 mile north of MacKerricher State Park.	M. Sallinen	Dug	Domestic	12	—	48	—	—	Yes	—	Yes
19N/17W-30G1	West side of State Highway 1, 0.7 mile south of MacKerricher State Park.	A. Galianni	Dug	Domestic	12	—	36	—	Yes	Yes	—	Yes
19N/17W-31P1	0.4 mile east of State Highway 1, 0.6 mile north of Pudding Creek.	H. D. Hicker	Dug	Domestic	18	—	36	—	Yes	Yes	—	Yes
19N/18W-36J1	West side of State Highway 1, 0.7 mile north of Pudding Creek.	—	Dug	Domestic	14	—	48	—	Yes	Yes	—	—
20N/17W-33M1	0.1 mile west of State Highway 1, 0.5 mile north of Ten Mile River.	C. P. Johnson	Dug	Domestic	17	—	48	—	Yes	Yes	—	Yes
21N/17W-6M1	East side of State Highway 1, north side of Juan Creek.	Union Landing	—	—	—	—	—	—	—	—	Yes	—
21N/17W-29E1	East side of State Highway 1, 0.5 mile north of Westport.	Oscar Poe Shoreline Cafe	Dug	Domestic	17	—	36	—	—	Yes	Yes	Yes
21N/17W-29N1	West side of State Highway 1, at north city limits of Westport.	Westport Motel	Dug	Domestic	19	—	48	—	—	Yes	Yes	Yes
		POINT ARENA TERRACE AND CONTIGUOUS AREAS										
11N/15W-22C1	West side of Brush Opening Road, 2.1 miles north of State Highway 1.	E. Reynolds	Dug	Domestic	29	—	60	Yes	Yes	—	Yes	—
11N/15W-28H1	West side of State Highway 1, 0.8 mile north of Gualala.	Home and Sawbuck Lumber Company	Dug	Domestic	20	—	48	—	Yes	Yes	—	Yes
11N/15W-34B1	1,000 feet southwest of State Highway 1, northwest of Gualala River.	Empire Lumber Company	Drilled	Domestic and Industrial	50	—	—	—	—	Yes	—	Yes

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Data available: Water levels	Data available: Construction survey	Water analyses: Mineral	Water analyses: Bacteriol
11N/16W-2N1	West side of State Highway 1, 1.8 miles south of Iverson Ridge Road.	R. Beebe	Drilled	Domestic	118	—	8	—	—	Yes	—	Yes
11N/16W-3G1	East side of State Highway 1, 0.7 mile south of Iverson Ridge Road.	R. W. Ratcliff	Drilled	Domestic	160	—	—	—	—	Yes	—	Yes
11N/16W-13B1	West side of State Highway 1, 0.6 mile north of Fish Rock Road.	A. C. Worden	Drilled	Domestic	127	—	6	—	Yes	Yes	Yes	—
11N/16W-13H1	West side of State Highway 1, 0.2 mile north of Fish Rock Road.	Lincheld	Dug	Domestic	30	—	48	—	Yes	Yes	—	—
12N/16W-6D1	0.3 mile east of Iverson Indian Reservation Road, 1.0 mile south of State Highway 1.	Iverson Indian Rancheria	Dug	Domestic	20	—	72	—	Yes	Yes	—	Yes
12N/16W-6Q1	1.0 mile east of Iverson Indian Reservation Road, 1.0 mile northeast of Point Arena.	Haliday	Dug	Domestic and Irrigation	12	—	60	—	Yes	Yes	—	—
12N/16W-18L1	0.5 mile east of State Highway 1, 0.8 mile south of River Road in Point Arena.	Kenny	Dug	Domestic	6	—	48	—	Yes	Yes	—	—
12N/16W-30A1	West side of State Highway 1, 2.6 miles south of River Road in Point Arena.	P. H. Cox	Drilled	Domestic	86	—	—	—	—	Yes	—	—
12N/17W-2K1	West side of State Highway 1, north of Point Arena Lighthouse Road.	W. J. Wainwright	Drilled	Domestic and Irrigation	40	—	8	—	—	Yes	—	Yes
12N/17W-3J1	0.7 mile south of Point Arena Lighthouse Road, 1.0 mile west of State Highway 1.	U.S. Coast Guard	Drilled	Domestic	120	—	6	—	—	Yes	—	—
12N/17W-12L1	East side of State Highway 1 at State Division of Forestry Station in Point Arena.	State Division of Forestry	Drilled	Domestic	200	—	6	Yes	—	Yes	—	Yes
12N/17W-12P1	1,000 feet southeast of State Division of Forestry Station in Point Arena.	Pellascio	Dug	Domestic	15	—	60	—	Yes	Yes	—	Yes
12N/17W-13A1	South side of River Road, 1,000 feet east of State Highway 1.	W. Hay	Drilled	Domestic and Municipal	56	—	8	—	—	Yes	—	—
12N/17W-13B1	West side of State Highway 1, south side of River Road, in Point Arena.	H. C. Beebe	Dug	Domestic	30	—	72	—	Yes	Yes	—	—
12N/17W-13L1	0.3 mile west of State Highway 1, 0.6 mile south of River Road.	Pedretti	Dug	Abandoned	—	—	48	—	Yes	Yes	—	—
13N/16W-30D1	East side of State Highway 1, 0.2 mile north of Manchester.	Sjolund and Behrens	Drilled	Domestic	109	—	6	—	Yes	Yes	—	Yes
13N/17W-25B1	0.5 mile west of State Highway 1, 0.2 mile north of Manchester.	M. Cremonini	Dug	Domestic	20	—	48	—	Yes	Yes	—	—
13N/17W-34C1	Point Arena Lighthouse.	United States Coast Guard	Drilled	Domestic	80	—	(0–54) 6 (50–80) 8	Yes	—	Yes	—	—
13N/17W-35G1	1.2 mile west of State Highway 1, at junction with Mountain View Road.	Stornetta Brothers	Drilled	Domestic	150	—	8	—	—	Yes	—	—

TABLE I
WELL DATA
MENDOCINO COUNTY

Well number M.D.B.&M.	Location	Owner	Type	Use	Total depth in feet	Perforation interval in feet	Size of casing in inches	Data available: Log	Water levels	Construction survey	Water analyses: Mineral	Bacterial
13N/17W-36M1	West side of State Highway 1, 0.8 mile south of Mountain View Road.	W. Stornetta	Drilled	Domestic	—	—	—	Yes	Yes	Yes	Yes	—
13N/17W-36Q1	0.3 mile west of Iverson Indian Reservation Road, 0.8 mile south of Mountain View Road.	D. Stornetta	Drilled	Irrigation	28	—	12	—	Yes	Yes	—	—
15N/16W-19L1	1,000 feet north of Greenwood Ridge Road, 2.2 miles northeast of State Highway 1.	Liljebergs	—	—	—	—	—	—	—	—	Yes	—
15N/16W-32H1	1.0 mile north of Cliff Ridge Road, 4.1 miles east of State Highway 1.	—	—	—	—	—	—	—	—	—	Yes	—
15N/17W-22Q1	East side of State Highway 1, 1.2 miles north of Elk.	Cummings	Dug	Domestic	22	—	36	—	Yes	Yes	—	Yes
15N/17W-26P1	East side of State Highway 1, south of Elk.	Ruben's Oasis	Dug	Domestic	25	—	24	—	Yes	Yes	—	Yes
	MISCELLANEOUS AREAS AND MINOR VALLEYS											
12N/11W-19D1	West side of State Highway 128, 7.5 miles east of Yorkville.	J. Haehl	Drilled	Domestic	32	—	8	—	—	Yes	Yes	—
13N/13W-11N1	West side of unnamed Ridge Road, 3.0 miles south of Ukiah Boonville Road, 3.0 miles east of Boonville.	H. Page	Spring	Domestic	—	—	—	—	—	—	Yes	—
16N/16W-12B1	North side of Comptche Orrs Spring Road at Comptche Store.	J. Gummerus	Dug	Domestic	14	—	42	Yes	Yes	Yes	Yes	—
17N/16W-35R1	500 feet north of North Fork of Albion River at Picnic Grounds, 1.5 miles northwest of Comptche.	—	Spring	Domestic	—	—	—	—	—	—	Yes	—
19N/12W-31Q1	North side of Hearst Road, 0.2 mile west of Scott Creek at south end of Scott Creek Valley.	—	Dug	Irrigation	—	—	24	—	—	Yes	Yes	—
21N/12W-34M1	Eden Valley Ranch, Eden Valley.	Eden Valley Ranch	Drilled	Domestic and Irrigation	31	—	12	—	Yes	Yes	Yes	—
21N/16W-22K1	0.1 mile north of Branscomb Westport Road, 0.2 mile west of Branscomb.	Pierson	Dug	Domestic	15	—	48	—	Yes	Yes	Yes	—
21N/16W-26C1	South side of Branscomb Laytonville Road, 0.3 mile southeast of Branscomb.	—	Dug	Domestic	—	—	—	—	—	—	Yes	—
22N/18W-24F1	Next to church at north end of Rockport on county road.	—	Spring	Domestic	—	—	—	—	—	—	Yes	—
22N/18W-36R1	East side of State Highway 1, 3.0 miles south of Rockport.	V. Ross	Spring	Domestic	—	—	—	—	—	—	Yes	—
23N/12W-26E1	Poor Mans Valley, 5.0 miles northeast of Covelo.	Rhyne	Drilled	Domestic	18	—	8	—	Yes	—	Yes	—
23N/17W-10A1	North side of Hales Grove Road, 0.5 mile west of U.S. Highway 101.	J. Senteney	Dug	Irrigation	18	—	48	—	Yes	Yes	Yes	—
23N/17W-11E1	West side of U.S. Highway 101, 0.4 mile south of Leggett.	J. O. Sutton	Drilled	Domestic	30	—	8	—	Yes	Yes	Yes	—
24N/17W-6D1	North side of U.S. Highway 101, 1.0 mile south of Piercy	Romero	Dug	Domestic	19	—	36 x 48	—	Yes	Yes	Yes	—

TABLE 2

MINERAL ANALYSES OF SURFACE WATER[a]

MENDOCINO COUNTY

Source	Location number M.D.B.&M.	Date sampled	Discharge in cfs	Temp in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[b]	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm
							Mineral constituents in parts per million / equivalents per million																
									ANDERSON VALLEY														
Soda Creek	13N/13W-5	3-5-53	2	43	240	7.8	18 0.90	9.5 0.78	17 0.74	1.0 0.03	0.0 0.00	121 1.98	14 0.29	9.5 0.27	0.1 0.00	0.0 0.00	0.97	17	(c)	146	30	84	0
Anderson Creek	13N/14W-12G1S	3-5-53	7	41	272	8.0	29 1.45	11 0.90	12 0.52	0.7 0.02	0.0 0.00	144 2.36	17 0.35	7.5 0.21	0.1 0.00	0.0 0.00	0.10	17	Zn-0.01 (c)	165	18	118	0
Robinson Creek	13N/14W-12M1S	3-5-53	1	47	322	7.6	27 1.35	20 1.64	10 0.44	0.8 0.02	0.0 0.00	169 2.77	21 0.44	7.5 0.21	0.7 0.01	0.1 0.00	0.05	12		182	13	150	11
Navarro River	14N/14W-19G1S	3-5-53	45	51	227	7.8	23 1.15	9.6 0.79	10 0.44	0.9 0.02	0.0 0.00	116 1.90	13 0.27	8.0 0.23	0.1 0.00	0.1 0.00	0.12	17	(c)	139	18	97	2
Indian Creek	14N/14W-20D1S	3-5-53	20	47	283	7.7	30 1.50	11 0.90	16 0.70	1.5 0.04	0.0 0.00	154 2.52	19 0.40	8.0 0.23	0.2 0.00	0.1 0.00	0.11	16	(c)	178	22	120	0
Con Creek	14N/14W-34G1S	3-5-53	-	48	347	8.1	35 1.75	16 1.32	16 0.70	1.4 0.04	0.0 0.00	174 2.85	29 0.60	9.5 0.27	0.3 0.00	0.1 0.00	0.14	18	Zn-0.02 (c)	211	18	153	11
Mill Creek	15N/15W-34M1S	3-5-53	3	42	295	7.6	29 1.45	11 0.90	15 0.65	1.7 0.04	0.0 0.00	126 2.06	30 0.62	14 0.40	0.2 0.00	0.1 0.00	0.07	16	(c)	179	21	118	14
									SANEL VALLEY														
Russian River	13N/11W-19J1S	7-6-50	-	-	211	-	24 1.20	8.0 0.66	13 0.57	-	0.0 0.00	114 1.86	11 0.23	12 0.34	0.1 0.00	-	0.93	-		-	24	93	0
Russian River	13N/11W-19J1S	7-12-50	-	-	231	-	28 1.40	9.0 0.74	7.5 0.32	-	0.0 0.00	120 1.96	11 0.24	9.6 0.27	0.0 0.00	-	1.50	-		-	13	107	9
Russian River	14N/12W-36K1S	5-8-51	574	59	198	7.7	21 1.05	9.2 0.76	5.6 0.24	0.9 0.02	0.0 0.00	107 1.75	11 0.23	3.8 0.11	1.2 0.02	-	0.44	13		118[d]	12	90	3
Russian River	14N/12W-36K1S	9-9-51	125	72	210	8.3	23 1.15	9.0 0.74	7.5 0.33	1.0 0.03	0.0 0.00	120 1.97	9.0 0.19	4.2 0.12	1.3 0.02	0.0 0.00	0.33	11		125	15	94	0
Russian River	14N/12W-36K1S	5-19-52	374	66	166	7.6	18 0.90	7.0 0.58	6.1 0.26	0.9 0.02	0.0 0.00	89 1.46	8.6 0.18	5.5 0.16	0.4 0.01	0.0 0.00	0.29	17	(c)	108	15	74	1
Russian River	14N/12W-36K1S	1-12-53	3,340	57	143	7.3	13 0.65	6.4 0.53	6.7 0.29	1.2 0.03	0.0 0.00	72 1.18	-	5.0 0.14	-	-	-	-		-	19	59	0
Russian River	14N/12W-36K1S	3-9-53	308	50	179	7.5	21 1.05	7.0 0.58	8.2 0.36	-	0.0 0.00	98 1.61	-	5.0 0.14	-	-	0.38	-		-	18	81	1
Russian River	14N/12W-36K1S	5-4-53	485	72	184	7.6	18 0.90	8.3 0.68	7.8 0.34	1.1 0.03	0.0 0.00	97 1.59	11 0.23	4.8 0.14	1.8 0.03	0.2 0.01	0.22	14	Zn-0.03; Al-0.02 (c)	115	17	79	0

TABLE 2

MINERAL ANALYSES OF SURFACE WATER[a]

MENDOCINO COUNTY

Source	Location number M.D.B.&M.	Date sampled	Discharge in cfs	Temp in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[b]	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm
							Mineral constituents in parts per million / equivalents per million																
									LAYTONVILLE VALLEY														
Ten Mile Creek	21N/14W-20D1S	3-3-53	0.5	50	139	7.6	13 / 0.65	7.5 / 0.62	4.5 / 0.20	0.7 / 0.02	0.0 / 0.00	72 / 1.18	10 / 0.21	4.0 / 0.11	0.1 / 0.00	0.0 / 0.00	0.08	12	(c)	87	13	63	4
Long Valley Creek	21N/14W-31Q1S	3-4-53	1.0	35	132	7.1	9.7 / 0.48	8.2 / 0.67	5.4 / 0.24	1.1 / 0.03	0.0 / 0.00	70 / 1.15	5.3 / 0.11	5.0 / 0.14	0.7 / 0.01	0.1 / 0.00	0.60	8.2	(c)	78	17	58	1
Mud Springs Creek	21N/15W-10B1S	3-3-53	5	35	95.3	7.5	5.3 / 0.26	5.3 / 0.44	7.4 / 0.32	0.9 / 0.02	0.0 / 0.00	56 / 0.92	2.2 / 0.05	3.5 / 0.10	0.2 / 0.00	0.0 / 0.00	0.04	14	(c)	66	31	35	0
Ten Mile Creek	21N/15W-11H1S	3-4-53	5	40	187	7.5	17 / 0.85	5.6 / 0.46	13 / 0.56	0.7 / 0.02	0.0 / 0.00	82 / 1.34	4.9 / 0.10	17 / 0.48	0.2 / 0.00	0.0 / 0.00	0.53	15	Zn-0.02 (c)	114	30	65	0
Sulphur Springs Creek	21N/15W-12B1S	3-3-53	0.7	60	1,620	7.8	80 / 3.99	12 / 0.99	246 / 10.70	3.5 / 0.09	0.0 / 0.00	246 / 4.03	5.6 / 0.12	395 / 11.14	1.9 / 0.03	0.3 / 0.02	16	36	(c)	918	68	249	48
Mill Creek	21N/15W-15F1S	3-3-53	4	40	86.9	7.5	7.4 / 0.37	3.3 / 0.27	7.4 / 0.32	0.7 / 0.02	0.0 / 0.00	48 / 0.79	5.7 / 0.12	3.0 / 0.08	0.1 / 0.00	0.0 / 0.00	0.07	15	Fe-0.1 (c)	66	33	32	0
Cahto Creek	21N/15W-22F1S	3-3-53	3	38	92.6	7.2	8.3 / 0.41	3.0 / 0.25	7.0 / 0.30	0.7 / 0.02	0.0 / 0.00	52 / 0.85	3.7 / 0.08	3.0 / 0.08	0.2 / 0.00	0.0 / 0.00	0.06	17	Fe-0.1 (c)	68	31	33	0
Lewis Creek	22N/15W-14	3-3-53	0.25	44	200	7.3	22 / 1.10	8.3 / 0.68	7.8 / 0.34	0.4 / 0.01	0.0 / 0.00	117 / 1.92	7.2 / 0.15	3.0 / 0.08	0.2 / 0.00	0.0 / 0.00	0.39	25	(c)	132	16	89	0
Ten Mile Creek	22N/15W-22E1S	3-3-53	15	42	128	7.1	12 / 0.60	4.5 / 0.37	7.8 / 0.34	0.6 / 0.02	0.0 / 0.00	63 / 1.03	5.1 / 0.11	7.0 / 0.20	0.3 / 0.00	0.1 / 0.00	0.21	11	Zn-0.02 (c)	79	26	48	0
Big Rock Creek	22N/15W-27L1S	3-3-53	4	38	96.4	7.5	7.9 / 0.39	4.7 / 0.39	5.8 / 0.25	0.9 / 0.02	0.0 / 0.00	53 / 0.87	4.1 / 0.08	4.0 / 0.11	0.2 / 0.00	0.0 / 0.00	0.01	13	Fe-0.1 (c)	67	24	39	0
									LITTLE LAKE VALLEY														
Berry Creek	18N/13W-10M1S	5-8-53	2	48	177	7.6	18 / 0.90	7.9 / 0.65	6.1 / 0.26	1.2 / 0.03	0.0 / 0.00	100 / 1.64	6.4 / 0.13	3.5 / 0.10	0.4 / 0.01	0.1 / 0.00	0.03	16	Fe-0.1 (c)	109	14	77	0
Moore Creek	18N/13W-28H1S	5-7-53	2	45	105	7.5	7.8 / 0.39	5.7 / 0.47	4.1 / 0.18	1.0 / 0.03	0.0 / 0.00	53 / 0.87	5.8 / 0.12	3.0 / 0.08	0.6 / 0.01	0.2 / 0.01	0.01	10	Fe-0.1 (c)	64	17	43	0
Davis Creek	18N/13W-28J1S	5-7-53	15	55	114	7.5	12 / 0.60	4.7 / 0.39	4.5 / 0.20	1.2 / 0.03	0.0 / 0.00	62 / 1.02	5.1 / 0.11	2.5 / 0.07	1.1 / 0.02	0.2 / 0.01	0.04	14	Fe-0.3 (c)	76	16	49	0
Haehl Creek	18N/13W-30J1S	5-7-53	3	57	144	7.7	10 / 0.50	7.6 / 0.62	6.9 / 0.30	1.1 / 0.03	0.0 / 0.00	70 / 1.15	10 / 0.21	4.0 / 0.11	1.1 / 0.02	0.1 / 0.00	0.06	10	Fe-0.2 (c)	85	21	56	0

TABLE 2
MINERAL ANALYSES OF SURFACE WATER[a]
MENDOCINO COUNTY

Source	Location number M.D.B.&M.	Date sampled	Discharge in cfs	Temp in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[b]	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm
							Mineral constituents in parts per million / equivalents per million																
									LITTLE LAKE VALLEY (continued)														
Baechtel Creek	18N/13W-30M1S	5-7-53	8	61	113	7.4	10 0.50	5.0 0.41	5.0 0.22	1.5 0.04	0.0 0.00	57 0.93	7.0 0.15	3.0 0.08	1.0 0.02	0.3 0.02	0.04	13	Fe-0.5 (c)	74	19	46	0
Willits Creek	18N/14W-11B1S	5-8-53	10	46	87.2	7.4	8.2 0.41	2.5 0.21	7.4 0.32	1.0 0.03	0.0 0.00	48 0.79	3.3 0.07	3.8 0.11	0.4 0.01	0.3 0.02	0.01	16	Fe-0.6; Zn-0.02 (c)	66	33	31	0
Broaddus Creek	18N/14W-14R1S	5-7-53	10	54	127	7.3	10 0.50	5.7 0.47	6.1 0.26	1.1 0.03	0.0 0.00	63 1.03	7.8 0.16	3.0 0.08	0.3 0.00	0.2 0.01	0.09	11	Fe-0.1 (c)	76	21	48	0
Outlet Creek	19N/13W-31C1S	5-8-53	35	52	138	7.3	12 0.60	5.9 0.48	7.8 0.34	1.4 0.04	0.0 0.00	70 1.15	6.1 0.13	4.2 0.12	0.7 0.01	0.2 0.01	0.19	13	Fe-0.3 (c)	86	23	54	0
									POTTER VALLEY														
Mewhinney Creek	16N/11W-4L1S	6-26-53	2	63	382	8.1	37 1.85	20 1.64	15 0.65	0.9 0.02	0.0 0.00	176 2.88	45 0.94	9.5 0.27	1.2 0.02	0.1 0.00	0.18	12	(c)	227	16	175	30
East Fork Russian River	17N/11W-6E1S	5-19-52	306	59	124	7.0	15 0.75	3.9 0.32	3.7 0.16	0.6 0.02	0.0 0.00	66 1.08	6.3 0.13	2.5 0.07	0.2 0.00	0.2 0.01	0.19	15	(c)	80	13	54	0
East Fork Russian River	17N/11W-6E1S	1-12-53	-	56	177	7.2	15 0.75	12 0.99	2.8 0.12	1.0 0.03	0.0 0.00	108 1.77	-	1.0 0.03	-	-	-	-		-	6	87	0
East Fork Russian River	17N/11W-6E1S	2-13-53	-	54	113	7.5	13 0.65	4.2 0.34	4.5 0.20	0.9 0.02	0.0 0.00	62 1.02	-	2.2 0.06	-	-	-	-		-	16	50	0
East Fork Russian River	17N/11W-6E1S	5-4-53	-	63	126	7.6	15 0.75	4.5 0.37	4.3 0.18	0.7 0.02	0.0 0.00	68 1.11	7.0 0.15	3.0 0.08	0.5 0.01	0.1 0.00	0.06	10	(c)	78	14	56	0
East Fork Russian River	17N/11W-6E1S	6-25-53	200	59	142	7.9	17 0.85	6.1 0.50	4.5 0.20	0.6 0.02	0.0 0.00	78 1.28	6.9 0.14	3.5 0.10	0.2 0.00	0.0 0.00	0.13	11	Zn-0.01 (c)	88	13	68	4
Hawn Creek	17N/11W-18M1S	6-18-53	0.5	65	212	8.2	22 1.10	11 0.90	6.5 0.28	1.0 0.03	0.0 0.00	118 1.93	10 0.21	5.5 0.16	0.4 0.01	0.1 0.00	0.04	14	(c)	129	12	100	3
Unnamed Creek	17N/11W-28R1S	6-25-53	2	70	344	8.3	38 1.90	14 1.15	15 0.65	0.8 0.02	0.0 0.00	161 2.64	43 0.90	6.5 0.18	0.2 0.00	0.1 0.00	0.11	19	(c)	216	18	152	20
Bush Creek	17N/12W-12D1S	6-16-53	0.4	85	349	8.5	28 1.40	22 1.81	17 0.74	1.5 0.04	8.1 0.27	180 2.95	18 0.38	9.0 0.25	0.8 0.01	0.1 0.00	0.67	17	(c)	210	19	160	0

TABLE 2
MINERAL ANALYSES OF SURFACE WATER[a]
MENDOCINO COUNTY

Source	Location number M.D.B.&M.	Date sampled	Discharge in cfs	Temp in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[b]	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm
							Mineral constituents in parts per million / equivalents per million																
ROUND VALLEY																							
Mill Creek	22N/12W-22G1S	3-4-53	30	60	266	8.6	26 / 1.30	16 / 1.32	7.4 / 0.32	1.0 / 0.03	6.0 / 0.20	144 / 2.36	12 / 0.25	4.8 / 0.14	0.8 / 0.01	0.1 / 0.00	0.07	13	(c)	158	11	131	3
Town Creek	22N/13W-2G1S	3-4-53	4	57	243	7.3	26 / 1.30	11 / 0.90	6.9 / 0.30	0.9 / 0.02	0.0 / 0.00	125 / 2.05	16 / 0.33	5.8 / 0.16	0.1 / 0.00	0.1 / 0.00	0.04	14	(c)	142	12	110	8
Turner Creek	22N/13W-24P1S	3-4-53	4	60	286	8.0	28 / 1.40	11 / 0.90	16 / 0.70	0.9 / 0.02	0.0 / 0.00	134 / 2.20	23 / 0.48	13 / 0.37	0.1 / 0.00	0.0 / 0.00	0.18	13	(c)	171	23	115	5
Unnamed Creek	23N/12W-19M1S	3-4-53	0.5	50	167	7.5	12 / 0.60	11 / 0.90	6.1 / 0.26	1.2 / 0.03	0.0 / 0.00	95 / 1.56	5.7 / 0.12	4.2 / 0.12	1.1 / 0.02	0.1 / 0.00	0.04	7.8	(c)	96	15	75	0
Short Creek	23N/12W-28K1S	3-4-53	4	48	129	7.4	12 / 0.60	5.5 / 0.45	5.0 / 0.22	1.1 / 0.03	0.0 / 0.00	60 / 0.98	13 / 0.27	3.5 / 0.10	0.2 / 0.00	0.0 / 0.00	0.01	9.8	(c)	80	17	53	3
Mill Creek	23N/13W-36D1S	3-4-53	5	52	191	7.8	23 / 1.15	6.8 / 0.56	5.4 / 0.24	0.8 / 0.02	0.0 / 0.00	99 / 1.62	13 / 0.27	3.5 / 0.10	0.2 / 0.00	0.0 / 0.00	0.07	12	Zn-0.01 (c)	114	12	85	4
UKIAH VALLEY																							
Robertson Creek	14N/12W-7B1S	8-31-53	2	68	202	7.9	23 / 1.15	8.2 / 0.67	7.6 / 0.33	0.5 / 0.01	0.0 / 0.00	107 / 1.75	10 / 0.21	4.5 / 0.13	0.4 / 0.01	0.2 / 0.01	0.14	19		126	15	91	3
Morrison Creek	14N/12W-11R1S	10-7-53	0.5	61	602	8.5	46 / 2.30	35 / 2.88	15 / 0.65	1.1 / 0.03	12 / 0.40	268 / 4.39	41 / 0.85	6.0 / 0.17	0.4 / 0.01	0.2 / 0.01	0.88	18	Pb-0.02; Zn-0.01 (c)	306	11	259	20
Sulphur Creek	15N/12W-16G1S	9-1-53	0.4	67	1,030	8.5	26 / 1.30	16 / 1.32	193 / 8.39	7.1 / 0.18	35 / 1.17	512 / 8.39	14 / 0.29	53 / 1.49	1.0 / 0.02	0.5 / 0.03	13	28		639	75	131	0
Russian River	15N/12W-16Q1S	7-6-50	-	-	176	-	21 / 1.05	7.5 / 0.62	7.4 / 0.32	-	-	99 / 1.62	8.2 / 0.17	7.0 / 0.20	0.1 / 0.00	-	0.15	-		-	16	83	2
Russian River	15N/12W-16Q1S	7-12-50	-	-	172	-	23 / 1.15	8.0 / 0.66	6.4 / 0.28	-	-	97 / 1.59	13.7 / 0.28	7.5 / 0.21	0.0 / 0.00	-	0.16	-		-	13	90	11
Middle Creek	15N/12W-26G1S	9-1-53	0.2	60	456	8.0	63 / 3.14	13 / 1.07	19 / 0.83	1.9 / 0.05	0.0 / 0.00	279 / 4.57	10 / 0.21	10 / 0.28	0.4 / 0.01	0.5 / 0.03	1.6	28		285	16	210	0
Russian River	15N/12W-28B1S	5-10-51	-	64	179	7.5	20 / 1.00	7.5 / 0.62	5.0 / 0.22	0.9 / 0.02	0.0 / 0.00	97 / 1.59	10 / 0.21	3.2 / 0.09	0.0 / 0.00	-	0.30	12		107[d]	12	81	1
Russian River	15N/12W-28B1S	9-9-51	-	74	194	8.2	22 / 1.10	8.0 / 0.66	6.0 / 0.26	0.9 / 0.02	0.0 / 0.00	110 / 1.80	8.0 / 0.17	4.0 / 0.11	0.5 / 0.01	0.0 / 0.00	0.36	10		114	13	88	0
Russian River	15N/12W-28B1S	5-19-52	-	66	167	7.5	17 / 0.85	7.3 / 0.60	5.5 / 0.24	0.5 / 0.01	0.0 / 0.00	90 / 1.48	8.4 / 0.18	3.2 / 0.09	0.3 / 0.00	0.0 / 0.00	0.29	21	Sn-0.20 (c)	107	14	72	0

TABLE 2
MINERAL ANALYSES OF SURFACE WATER[a]
MENDOCINO COUNTY

Source	Location number M.D.B.&M.	Date sampled	Discharge in cfs	Temp in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[b]	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm
							Mineral constituents in parts per million / equivalents per million																
UKIAH VALLEY (continued)																							
Russian River	15N/12W-28B1S	1-12-53	-	56	212	7.4	28 / 1.40	6.2 / 0.51	7.2 / 0.31	1.4 / 0.04	0.0 / 0.00	116 / 1.90	-	4.0 / 0.11	-	-	-	-		-	14	95	0
Russian River	15N/12W-28B1S	4-1-53 to 4-30-53	-	-	163	8.0	17 / 0.85	7.1 / 0.58	6.5 / 0.28	0.7 / 0.02	0.0 / 0.00	88 / 1.44	9.5 / 0.20	3.5 / 0.10	0.0 / 0.00	0.0 / 0.00	0.19	14	Total Fe-0.0	102	16	72	0
Russian River	15N/12W-28B1S	5-4-53	-	68	224	8.0	27 / 1.35	8.1 / 0.67	8.2 / 0.36	1.0 / 0.03	0.0 / 0.00	122 / 2.00	12 / 0.25	4.5 / 0.13	0.6 / 0.01	0.2 / 0.01	0.15	14	Zn-0.02; Al-0.01 (c)	136	15	101	1
East Fork Russian River	16N/12W-13L1S	10-26-50	-	-	163	8.7	19 / 0.95	6.7 / 0.55	6.5 / 0.28	8.0 / 0.20	6.0 / 0.20	80 / 1.31	7.7 / 0.16	3.2 / 0.09	0.0 / 0.00	-	1.06	3.2		100	14	75	0
East Fork Russian River	16N/12W-13L1S	5-16-51	-	64	165	8.0	19 / 0.95	7.3 / 0.60	5.0 / 0.22	0.7 / 0.02	0.0 / 0.00	91 / 1.49	9.5 / 0.20	3.5 / 0.10	0.0 / 0.00	-	0.47	12		102[d]	12	77	3
East Fork Russian River	16N/12W-13L1S	9-9-51	-	73	192	8.1	22 / 1.10	7.5 / 0.62	6.0 / 0.26	1.0 / 0.03	0.0 / 0.00	106 / 1.74	8.3 / 0.17	3.8 / 0.11	0.2 / 0.00	0.0 / 0.00	0.39	11		112	13	86	0
East Fork Russian River	16N/12W-13L1S	5-19-52	-	64	143	7.3	16 / 0.80	5.6 / 0.46	4.5 / 0.20	0.7 / 0.02	0.0 / 0.00	78 / 1.28	7.5 / 0.16	3.0 / 0.08	0.0 / 0.00	0.0 / 0.00	0.27	17	Sn-0.10 (c)	93	13	63	0
East Fork Russian River	16N/12W-13L1S	1-12-53	1,480	56	138	7.2	13 / 0.65	7.0 / 0.58	5.4 / 0.24	1.4 / 0.04	0.0 / 0.00	74 / 1.21	-	1.5 / 0.04	-	-	-	-		-	16	61	1
East Fork Russian River	16N/12W-13L1S	3-9-53	350	50	155	7.9	18 / 0.90	5.9 / 0.48	6.1 / 0.26	-	0.00 / 0.00	86 / 1.41	-	2.5 / 0.07	-	-	0.36	-		-	16	69	0
East Fork Russian River	16N/12W-13L1S	5-4-53	381	60	157	7.4	17 / 0.85	6.9 / 0.57	5.8 / 0.25	0.8 / 0.02	0.0 / 0.00	83 / 1.36	9.5 / 0.20	3.5 / 0.10	0.6 / 0.01	0.0 / 0.00	0.09	11	(c)	96	15	71	3
East Fork Russian River	16N/12W-27B1S	12-11-52	-	52	132	7.3	11 / 0.55	6.1 / 0.50	5.8 / 0.25	2.2 / 0.06	-	61 / 1.00	7.5 / 0.16	3.8 / 0.11	3.3 / 0.05	0.3 / 0.02	0.06	14		84	19	53	3
Russian River	16N/12W-33Q1S	7-6-50	-	-	244	-	28 / 1.40	10 / 0.82	17 / 0.75	-	-	150 / 2.46	9.2 / 0.19	12 / 0.32	0.0 / 0.00	-	0.07	-		-	25	111	0
Forsythe Creek	16N/13W-1C1S	9-1-53	2.5	79	236	8.3	27 / 1.35	9.3 / 0.76	9.1 / 0.40	1.2 / 0.03	0.0 / 0.00	130 / 2.13	8.7 / 0.18	7.2 / 0.20	0.5 / 0.01	0.2 / 0.01	0.00	14		140	16	106	0
Russian River	17N/12W-20D1S	9-1-53	0.5	70	298	7.9	30 / 1.50	15 / 1.23	10 / 0.44	1.3 / 0.03	0.0 / 0.00	160 / 2.62	13 / 0.27	12 / 0.34	0.6 / 0.01	0.3 / 0.02	0.18	17		178	14	137	5

TABLE 2
MINERAL ANALYSES OF SURFACE WATER[a]
MENDOCINO COUNTY

Source	Location number M.D.B.&M.	Date sampled	Discharge in cfs	Temp in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[b]	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm
							Mineral constituents in parts per million / equivalents per million																
FORT BRAGG TERRACE AND CONTIGUOUS AREAS																							
Big River	16N/17W-1A1S	7-9-53	-	-	200	7.4	19 / 0.95	7.6 / 0.62	11 / 0.48	1.3 / 0.03	0.0 / 0.00	104 / 1.70	7.2 / 0.15	7.5 / 0.21	0.3 / 0.00	0.1 / 0.00	0.15	16		121	23	79	0
Little River	16N/17W-5L1S	7-9-53	-	-	138	7.3	8.5 / 0.42	3.8 / 0.31	12 / 0.52	1.0 / 0.03	0.0 / 0.00	41 / 0.67	7.5 / 0.16	17 / 0.48	0.1 / 0.00	0.1 / 0.00	0.07	17		87	41	37	3
Big Salmon Creek	16N/17W-28N1S	7-9-53	-	-	297	7.0	11 / 0.55	6.9 / 0.57	37 / 1.61	2.1 / 0.05	0.0 / 0.00	52 / 0.85	11 / 0.23	57 / 1.61	0.3 / 0.00	0.2 / 0.01	0.03	17		168	59	56	13
South Fork Noyo River	17N/16W-4C1S	8-20-53	-	-	142	7.4	12 / 0.60	3.7 / 0.30	10 / 0.44	1.5 / 0.04	0.0 / 0.00	63 / 1.03	4.1 / 0.08	8.5 / 0.24	0.4 / 0.01	0.1 / 0.00	0.03	17		88	32	45	0
Russian Gulch	17N/17W-18P1S	7-9-53	-	-	137	7.3	5.5 / 0.27	2.7 / 0.22	15 / 0.65	0.9 / 0.02	0.0 / 0.00	28 / 0.46	5.3 / 0.11	19 / 0.54	0.6 / 0.01	0.1 / 0.00	0.02	16		79	56	25	2
Pudding Creek	18N/17W-6D1S	6-17-54	-	63	225	7.8	12 / 0.60	6.3 / 0.52	23 / 1.00	2.2 / 0.06	0.0 / 0.00	72 / 1.18	6.0 / 0.12	32 / 0.90	0.5 / 0.01	0.1 / 0.00	0.02	15	Fe-1.2; Pb, Zn-0.005 (c)	133	46	56	0
Newman Gulch	18N/17W-16D1S	6-23-53	-	-	82.4	6.6	2.5 / 0.12	1.4 / 0.12	12 / 0.52	0.7 / 0.02	0.0 / 0.00	15 / 0.25	2.1 / 0.04	18 / 0.51	0.2 / 0.00	0.0 / 0.00	0.02	16	Total Fe-0.1	60	67	12	0
Hare Creek	18N/17W-28B1S	6-23-53	-	-	87.7	7.1	2.9 / 0.14	1.4 / 0.12	12 / 0.52	1.0 / 0.03	0.0 / 0.00	20 / 0.33	2.6 / 0.05	18 / 0.51	0.0 / 0.00	0.0 / 0.00	0.01	20	Total Fe-0.2	68	65	13	0
Hare Creek	18N/18W-13R1S	6-16-54	-	57	122	7.4	7.3 / 0.36	2.4 / 0.20	13 / 0.56	0.9 / 0.02	0.0 / 0.00	30 / 0.49	5.3 / 0.11	19 / 0.54	0.2 / 0.00	0.5 / 0.03	0.00	19	Fe-0.2; Al-0.010; Pb, Zn-0.005 (c)	83	49	28	3
Jug Handle Creek	18N/18W-36K1S	7-9-53	-	-	194	7.4	14 / 0.70	3.5 / 0.29	19 / 0.83	1.1 / 0.03	0.0 / 0.00	57 / 0.93	6.5 / 0.14	28 / 0.79	0.5 / 0.01	0.1 / 0.00	0.66	16		117	45	49	3
South Fork Ten Mile River	19N/17W-3M1S	6-17-53	-	-	222	7.5	15 / 0.75	5.2 / 0.43	22 / 0.96	1.5 / 0.04	0.0 / 0.00	78 / 1.28	7.3 / 0.15	27 / 0.76	0.2 / 0.00	0.0 / 0.00	0.08	18	Total Fe-0.1	135	44	59	0
Mill Creek	19N/17W-19R1S	6-17-54	0.6	55	217	7.8	10 / 0.50	6.2 / 0.51	24 / 1.04	1.7 / 0.04	0.0 / 0.00	45 / 0.74	8.1 / 0.17	40 / 1.13	0.4 / 0.01	0.4 / 0.02	0.12	16	Fe-0.4; Al-0.010 (c)	129	50	50	13
Little Valley Creek	19N/17W-23C1S	6-16-53	-	-	231	7.2	13 / 0.65	7.7 / 0.63	22 / 0.96	1.2 / 0.03	0.0 / 0.00	70 / 1.15	4.7 / 0.10	36 / 1.02	0.2 / 0.00	0.1 / 0.00	0.09	13	Total Fe-0.9	132	42	64	7
Abalobodiah Creek	20N/17W-28M1S	6-16-53	-	-	207	7.3	17 / 0.85	5.2 / 0.43	15 / 0.65	1.0 / 0.03	0.0 / 0.00	81 / 1.33	9.5 / 0.20	20 / 0.56	0.0 / 0.00	0.2 / 0.01	0.02	16	Total Fe-0.1	124	33	64	0
Seaside Creek	20N/17W-33D1S	6-17-54	0.2	57	285	8.0	22 / 1.10	7.6 / 0.62	24 / 1.04	1.4 / 0.04	0.0 / 0.00	93 / 1.52	19 / 0.40	32 / 0.90	0.2 / 0.00	0.4 / 0.02	0.00	18	Pb, Zn-0.005 Fe-0.02 (c)	171	37	86	10
Ten Mile River	20N/17W-34M1S	6-17-53	-	-	153	7.7	13 / 0.65	5.0 / 0.41	8.2 / 0.36	1.2 / 0.03	0.0 / 0.00	75 / 1.23	4.0 / 0.08	6.5 / 0.18	0.1 / 0.00	0.0 / 0.00	0.04	18	Total Fe-0.1	93	25	53	0

TABLE 2
MINERAL ANALYSES OF SURFACE WATER[a]
MENDOCINO COUNTY

Mineral constituents in parts per million / equivalents per million (upper value: ppm; lower value: epm)

Source	Location number M.D.B.&M.	Date sampled	Discharge in cfs	Temp in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[b]	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm
							FORT BRAGG TERRACE AND CONTIGUOUS AREAS (continued)																
Juan Creek	21N/17W-6M1S	6-10-53	-	-	138	8.0	12 0.60	4.6 0.38	8.4 0.36	0.9 0.02	0.0 0.00	68 1.11	4.5 0.09	7.0 0.20	0.1 0.00	0.0 0.00	0.00	18	Total Fe-0.0	89	27	49	0
Howard Creek	21N/17W-17F1S	6-10-53	-	-	135	7.4	6.3 0.31	3.5 0.29	15 0.65	1.3 0.03	0.0 0.00	40 0.66	6.9 0.14	18 0.51	0.7 0.01	0.2 0.01	0.02	22	Total Fe-0.5	94	51	30	0
DeHaven Creek	21N/17W-20F1S	6-10-53	-	-	141	7.3	13 0.65	4.0 0.33	8.7 0.38	1.2 0.03	0.0 0.00	66 1.08	5.8 0.12	8.5 0.24	0.4 0.01	0.1 0.00	0.06	18	Fe-0.0	92	27	49	0
Wages Creek	21N/17W-29E1S	6-11-53	-	-	143	7.2	13 0.65	4.2 0.34	9.0 0.39	0.8 0.02	0.0 0.00	68 1.11	5.1 0.11	8.0 0.23	0.3 0.00	0.1 0.00	0.04	15	Fe-0.0	89	28	50	0
							POINT ARENA TERRACE AND CONTIGUOUS AREAS																
North Fork Gualala River	11N/15W-23Q1S	8-6-53	-	-	182	7.7	18 0.90	5.4 0.44	12 0.52	1.0 0.03	0.0 0.00	96 1.57	7.9 0.16	7.8 0.22	0.2 0.00	0.0 0.00	0.00	32	Total Fe-0.0	132	28	67	0
Garcia River	12N/16W-10C1S	7-30-53	-	-	193	7.6	19 0.95	5.9 0.48	12 0.52	1.0 0.03	0.0 0.00	99 1.62	9.0 0.19	8.2 0.23	0.2 0.00	0.0 0.00	0.01	33	Total Fe-0.0	137	26	72	0
Mate Creek	12N/16W-19Q1S	6-16-54	0.5	57	284	7.1	15 0.75	6.9 0.57	29 1.26	3.5 0.09	0.0 0.00	70 1.15	13 0.27	45 1.27	2.7 0.04	0.3 0.02	0.00	16	Fe-0.4; Al-0.010 (c)	166	47	66	9
Schooner Gulch	12N/16W-32A1S	6-16-54	2.5	55	227	7.4	21 1.05	5.5 0.45	15 0.65	1.5 0.04	0.0 0.00	79 1.30	16 0.33	20 0.56	0.0 0.00	0.4 0.02	0.00	19	Al, Pb, Zn-0.005 Fe-0.01 (c)	137	30	75	10
Point Arena Creek	12N/17W-13H1S	6-16-54	0.5	57	267	7.4	15 0.75	9.1 0.75	25 1.09	1.4 0.04	0.0 0.00	79 1.30	13 0.27	36 1.02	1.0 0.02	0.5 0.03	0.00	19	Fe-0.5; Al-0.20; Zn-0.005; Pb-0.010 (c)	159	41	75	10
Alder Creek	13N/17W-12L1S	6-16-54	7	61	190	9.1	19 0.95	5.7 0.47	13 0.56	0.8 0.02	0.0 0.00	94 1.54	10 0.21	8.2 0.23	0.3 0.00	0.1 0.00	0.11	20	Fe-0.01	123	28	71	0
Garcia River	13N/17W-36L1S	8-6-53	-	-	136	7.5	18 0.90	5.4 0.44	12 0.52	0.9 0.02	0.0 0.00	93 1.52	8.4 0.18	9.0 0.25	0.4 0.01	0.0 0.00	0.00	31	Total Fe-0.0	131	28	67	0
Navarro River	15N/15W-18M1S	10-26-50	-	-	222	8.9	24 1.20	9.0 0.74	8.8 0.38	4.2 0.11	10 0.33	96 1.57	18 0.38	4.0 0.11	0.0 0.00	-	0.25	4.7		130[d]	16	97	2
Navarro River	15N/17W-12M1S	7-9-53	-	-	269	7.5	25 1.25	11 0.90	14 0.61	1.5 0.04	0.0 0.00	139 2.28	12 0.25	10 0.28	0.2 0.00	0.1 0.00	0.10	16		158	22	108	0

TABLE 2
MINERAL ANALYSES OF SURFACE WATER[a]
MENDOCINO COUNTY

Source	Location number M.D.B.&M.	Date sampled	Discharge in cfs	Temp in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[b]	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm
							Mineral constituents in parts per million / equivalents per million																
MISCELLANEOUS AREAS AND MINOR VALLEYS																							
Tyler Creek	12N/9W-19K1S	10-13-53	-	-	180	7.7	15 0.75	10 0.82	6.5 0.28	0.9 0.02	0.0 0.00	95 1.56	9.6 0.20	3.5 0.10	0.4 0.01	0.1 0.00	0.02	8.3		101	15	79	1
Rancheria Creek	12N/12W-20Q1S	10-1-53	-	-	231	7.9	23 1.15	8.6 0.71	13 0.56	0.7 0.02	0.0 0.00	119 1.95	13 0.27	8.2 0.23	0.2 0.00	0.1 0.00	0.40	19		144	23	93	0
Rancheria Creek	12N/13W-1N1S	10-1-53	-	-	228	7.8	23 1.15	9.1 0.75	12 0.52	1.0 0.03	0.0 0.00	123 2.02	7.1 0.15	8.8 0.25	0.7 0.01	0.0 0.00	0.43	15		137	21	95	0
Albion River	16N/15W-8F1S	9-29-53	-	-	307	7.7	34 1.70	12 0.99	14 0.61	1.1 0.03	0.0 0.00	172 2.82	5.1 0.11	12 0.34	0.2 0.00	0.1 0.00	0.23	22		185	18	134	0
North Fork Big River	17N/15W-8M1S	8-20-53	-	-	226	8.0	23 1.15	7.9 0.65	12 0.52	1.5 0.04	0.0 0.00	121 1.98	5.8 0.12	8.5 0.24	0.4 0.01	0.1 0.00	0.19	21		140	22	90	0
Eel River	18N/11W-30H1S	10-26-50	-	-	166	9.0	20 1.00	6.4 0.53	6.3 0.27	2.8 0.07	8.9 0.30	78 1.28	6.9 0.14	3.6 0.10	0.0 0.00	-	0.36	4.3		98[d]	15	76	0
Noyo River	18N/15W-12E1S	8-27-53	-	-	191	7.8	19 0.95	6.9 0.57	11 0.48	1.2 0.03	0.0 0.00	107 1.75	4.9 0.10	6.2 0.18	0.2 0.00	0.0 0.00	0.14	15	Total Fe-0.1	117	24	76	0
North Fork Noyo River	18N/15W-17A1S	8-27-53	-	-	167	8.0	17 0.85	5.8 0.48	9.6 0.42	1.1 0.03	0.0 0.00	95 1.56	4.8 0.10	5.5 0.16	0.4 0.01	0.0 0.00	0.10	16	Total Fe-0.1	107	24	66	0
Eel River	19N/12W-20G1S	10-26-50	-	-	291	9.0	14 0.70	16 1.32	23 1.00	5.2 0.13	16 0.53	134 2.20	7.8 0.16	12 0.34	0.0 0.00	-	0.50	8.3		168[d]	32	101	0
Wheelbarrow Creek	19N/13W-17F1S	9-30-53	-	-	144	7.2	12 0.60	7.8 0.64	5.6 0.24	0.6 0.02	0.0 0.00	72 1.18	5.0 0.10	7.2 0.20	0.1 0.00	0.0 0.00	0.10	13		87	16	62	3
Sherwood Creek	19N/14W-6E1S	9-17-53	-	-	110	8.0	8.1 0.40	4.6 0.38	7.8 0.34	0.7 0.02	0.0 0.00	60 0.98	0.4 0.01	5.0 0.14	0.4 0.01	0.2 0.01	0.00	4.6		61	30	39	0
Eden Creek	20N/12W-10E1S	7-21-53	0.2	77	274	8.1	34 1.70	12 0.99	5.6 0.24	0.9 0.02	0.0 0.00	154 2.52	16 0.33	2.5 0.07	0.3 0.00	0.1 0.00	0.04	15		162	8	134	8
Outlet Creek	20N/14W-28L1S	9-30-53	-	-	351	7.6	35 1.75	12 0.99	22 0.96	1.4 0.04	0.0 0.00	171 2.80	6.6 0.14	26 0.73	0.5 0.01	0.1 0.00	2.0	10		200	26	137	0
Eden Creek	21N/12W-34D1S	7-21-53	2	77	288	8.0	32 1.60	17 1.40	4.8 0.21	1.1 0.03	0.0 0.00	176 2.88	10 0.21	2.5 0.07	0.5 0.01	0.1 0.00	0.03	15		170	6	150	6
Eel River	21N/13W-18F1S	10-26-50	-	-	267	8.7	24 1.20	11 0.91	13 0.57	6.0 0.15	18 0.60	92 1.51	19 0.40	12 0.34	0.0 0.00	-	0.92	4.7		153[d]	20	105	0
Middle Fork Eel River	22N/12W-2R1S	10-26-50	-	-	160	9.0	21 1.05	4.9 0.40	5.2 0.23	5.2 0.13	8.0 0.27	54 0.88	18 0.38	4.2 0.12	0.0 0.00	-	0.08	3.9		97[d]	12	73	15

TABLE 2
MINERAL ANALYSES OF SURFACE WATER[a]
MENDOCINO COUNTY

Source	Location number M.D.B.&M.	Date sampled	Discharge in cfs	Temp in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total dissolved solids in ppm[b]	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm
							Mineral constituents in parts per million / equivalents per million																
							MISCELLANEOUS AREAS AND MINOR VALLEYS (continued)																
Eel River	22N/13W-31P1S	10-28-50	-	-	277	8.8	29 / 1.45	10 / 0.82	12 / 0.52	9.2 / 0.24	11 / 0.37	104 / 1.70	25 / 0.52	15 / 0.42	0.0 / 0.00	-	0.35	9.1		171[d]	17	113	10
South Fork Eel River	22N/16W-33F1S	12-26-50	-	-	162	8.1	12 / 0.60	5.1 / 0.42	20 / 0.87	2.1 / 0.05	0.0 / 0.00	88 / 1.44	7.1 / 0.15	7.2 / 0.20	0.0 / 0.00	-	0.73	15		112[d]	45	51	0
Cottoneva Creek	22N/18W-11C1S	6-10-53	-	-	141	7.1	12 / 0.60	4.0 / 0.33	9.4 / 0.41	1.1 / 0.03	0.0 / 0.00	65 / 1.06	6.1 / 0.13	8.5 / 0.24	0.5 / 0.01	0.1 / 0.00	0.03	18	Fe-0.0	92	30	46	0
Cottoneva Creek	22N/18W-24N1S	6-10-53	-	-	142	7.3	13 / 0.65	4.3 / 0.35	9.2 / 0.40	1.5 / 0.04	0.0 / 0.00	71 / 1.16	5.0 / 0.10	7.2 / 0.20	0.5 / 0.01	0.1 / 0.00	0.03	18	Fe-0.4	94	28	50	0
South Fork Eel River	23N/17W-24R1S	10-26-50	-	-	170	9.1	21 / 1.05	4.2 / 0.34	10 / 0.44	3.6 / 0.09	8.9 / 0.30	77 / 1.26	7.4 / 0.15	7.5 / 0.21	0.1 / 0.00	-	0.35	11		112[d]	23	70	0
Mule Creek	23N/17W-29E1S	9-16-53	-	-	132	7.8	6.4 / 0.32	8.3 / 0.68	7.4 / 0.32	0.9 / 0.02	0.0 / 0.00	70 / 1.15	2.3 / 0.05	5.0 / 0.14	3.0 / 0.05	0.2 / 0.01	0.00	16		84	24	50	0
Mule Creek	23N/17W-30G1S	9-17-53	-	-	120	7.0	9.8 / 0.49	5.2 / 0.43	6.9 / 0.30	0.7 / 0.02	0.0 / 0.00	62 / 1.02	3.5 / 0.07	4.0 / 0.11	0.4 / 0.01	0.3 / 0.02	0.00	25		86	24	46	0
Jackass Creek	23N/18W-6D1S	8-25-53	-	-	214	8.0	21 / 1.05	6.8 / 0.56	12 / 0.52	1.0 / 0.03	0.0 / 0.00	105 / 1.72	7.5 / 0.16	12 / 0.34	0.3 / 0.00	0.1 / 0.00	0.03	17	Total Fe-0.0	129	24	80	0
Usal Creek	23N/18W-14K1S	6-10-53	-	-	110	7.5	10 / 0.50	3.6 / 0.30	6.1 / 0.26	0.6 / 0.02	0.0 / 0.00	56 / 0.92	3.8 / 0.08	4.5 / 0.13	0.1 / 0.00	0.0 / 0.00	0.00	18	Total Fe-0.0	74	25	40	0
Cole Creek	24N/13W-33A1S	10-6-53	-	-	139	7.5	16 / 0.80	4.8 / 0.40	4.1 / 0.18	1.1 / 0.03	0.0 / 0.00	77 / 1.26	3.7 / 0.08	2.2 / 0.06	0.2 / 0.00	0.0 / 0.00	0.06	11		81	13	60	0
Caulborn Creek	24N/18W-5B1S	10-8-53	-	-	104	7.4	9.4 / 0.47	3.1 / 0.26	6.9 / 0.30	0.6 / 0.02	0.0 / 0.00	47 / 0.77	3.8 / 0.08	6.0 / 0.17	0.2 / 0.00	0.1 / 0.00	0.04	15		68	29	36	0
Mattole River	H.B.&M. 5S/2E-27H1S	8-25-53	-	-	72	7.4	4.4 / 0.22	2.8 / 0.23	6.0 / 0.26	0.6 / 0.02	0.0 / 0.00	36 / 0.59	2.1 / 0.04	4.2 / 0.12	0.2 / 0.00	0.0 / 0.00	0.00	14	Total Fe-0.1	52	36	22	0

a Analyses by United States Geological Survey, Quality of Water Branch, Sacramento Laboratory.
b Unless otherwise noted, calculated from analyzed constituents.
c Iron (Fe), aluminum (Al), arsenic (As), copper (Cu), lead (Pb), manganese (Mn), zinc (Zn), and chromium (Cr), reported here as 0.0 / 0.00 except as shown.
d Gravimetric determination.

TABLE 3
MINERAL ANALYSES OF GROUND WATER[a]
MENDOCINO COUNTY

Source	Well number M.D.B.&M.	Date sampled	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total[b] dissolved solids in ppm	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
ANDERSON VALLEY																							
Domestic well	13N/14W-2Q1	3-10-53	—	259	7.9	23 1.15	10 0.82	15 0.65	0.6 0.02	0.0 0.00	119 1.95	4.1 0.08	10 0.28	12 0.27	0.1 0.00	0.04	21		159	25	98	1	
Domestic well	13N/14W-12M3	3-10-53	—	519	8.2	29 1.45	34 2.80	35 1.52	0.6 0.02	0.0 0.00	320 5.24	0.6 0.01	21 0.59	0.9 0.01	0.1 0.00	0.3	31	Total Fe 0.4 Mn 0.39	310	26	212	0	
Domestic well	14N/14W-18R2	7-30-53	—	152	6.6	8.0 0.40	4.6 0.38	14 0.61	0.4 0.01	0.0 0.00	51 0.84	6.7 0.14	15 0.42	0.3 0.00	0.1 0.00	0.04	29	Total Fe 0.1, Mn 0.01	103	44	39	0	
Domestic well	14N/14W-19A2	3-13-53	—	210	7.0	13 0.65	7.9 0.65	14 0.61	1.3 0.03	0.0 0.00	62 1.02	5.4 0.11	13 0.37	26 0.42	0.1 0.00	0.12	23	Total Fe 0.1 Mn 0.37	134	31	65	14	
Domestic well	14N/14W-19B1	7-30-53	—	196	6.8	17 0.85	7.4 0.61	14 0.61	1.0 0.03	0.0 0.00	114 1.87	1.6 0.03	8.0 0.23	0.5 0.01	0.2 0.01	0.03	48	Total Fe 5.2 Mn 0.69	154	29	73	0	
Domestic well	14N/14W-19N1	7-31-53	—	260	6.8	27 1.35	8.8 0.72	14 0.61	3.4 0.09	0.0 0.00	145 2.38	5.7 0.12	11 0.31	0.1 0.00	0.0 0.00	0.03	27	Total Fe 0.6 Mn 0.39	168	22	104	0	
Domestic well	14N/14W-20E2	3-13-53	—	281	7.9	17 0.85	13 1.07	24 1.04	0.9 0.02	0.0 0.00	160 2.62	0.7 0.02	12 0.34	1.5 0.02	0.2 0.01	0.10	54		202	35	96	0	
Domestic well	14N/14W-28K1	3-13-53	—	206	7.2	7.8 0.39	9.8 0.81	19 0.83	0.8 0.02	0.0 0.00	78 1.28	9.7 0.20	18 0.51	3.0 0.05	0.1 0.00	0.02	14		121	40	60	0	
Domestic well	14N/14W-34C1	7-30-53	—	210	6.9	13 0.65	11 0.90	13 0.56	0.6 0.02	0.0 0.00	98 1.61	4.0 0.08	11 0.31	7.0 0.11	0.1 0.00	0.05	37	Total Fe 0.0 Mn 0.01	145	26	78	0	
Domestic well	14N/14W-34C2	3-12-53	—	152	7.2	16 0.80	5.1 0.42	8.7 0.38	0.8 0.02	0.0 0.00	70 1.15	6.7 0.14	6.0 0.17	4.7 0.08	0.1 0.00	0.04	16	Total Fe 3.1 Mn 0.03	99	23	61	4	
Domestic well	14N/14W-34G6	3-12-53	—	671	8.4	32 1.60	19 1.56	87 3.75	0.8 0.02	0.0 0.00	294 4.82	0.3 0.01	66 1.86	0.9 0.01	1.4 0.07	2.7	25	Total Fe 0.2 Mn 0.21	330	54	158	0	
Domestic well	14N/15W-2Q1	7-29-53	—	455	7.0	26 1.30	20 1.64	37 1.61	0.6 0.02	0.0 0.00	117 1.92	78 1.52	38 1.07	0.7 0.01	0.2 0.01	0.08	34	Total Fe 4.7 Mn 0.41	292	35	147	51	
SANEL VALLEY																							
Domestic well	12N/11W-2F1	10-13-53	—	403	7.7	43 2.15	22 1.81	12 0.52	1.6 0.04	0.0 0.00	234 3.84	21 0.44	5.8 0.16	0.5 0.01	0.0 0.00	0.27	15		236	12	198	6	
Industrial well	13N/11W-7J1	4-15-55	140	—	—	—	—	—	—	—	—	—	—	—	—	690	—		—	—	—	—	
Industrial well	13N/11W-7J1	6-14-55	140	8,470	—	—	—	—	—	—	—	—	—	—	—	540	—		—	—	—	—	
Industrial well	13N/11W-7J1	6-21-55	140	8,500	7.9	43 2.15	1,330 109.55	1,020 44.35	36 0.92	0.0 0.00	4,120 67.58	9.1 0.19	1,220 34.41	0.8 0.01	—	404	76	Mn, Al 0.05 Cr, Cu Pb, Zn, Li 0.00	6,170	28	5,590	2,200	Ge - Present
Irrigation well	13N/11W-18Q1	6-23-53	—	287	7.0	19 0.95	12 0.99	23 1.00	1.3 0.03	0.0 0.00	136 2.23	13 0.27	16 0.45	2.9 0.05	0.0 0.00	3.4	15	Total Fe 0.1	173	34	97	0	

TABLE 3

MINERAL ANALYSES OF GROUND WATER[a]

MENDOCINO COUNTY

Source	Well number M.D.B.&M.	Date sampled	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
SANEL VALLEY (Continued)																							
Domestic well	13N/11W-19N1	6-16-53	—	293	7.3	25 / 1.25	19 / 1.56	6.1 / 0.26	0.6 / 0.02	0.0 / 0.00	157 / 2.57	20 / 0.42	5.8 / 0.16	0.8 / 0.01	0.0 / 0.00	0.11	19	Total Fe 0.1; Mn 0.00	174	9	140	12	
Domestic well	13N/11W-20C1	6-22-53	—	500	7.9	23 / 1.15	42 / 3.45	25 / 1.09	2.3 / 0.06	0.0 / 0.00	338 / 5.54	0.2 / 0.00	8.5 / 0.24	0.0 / 0.00	0.4 / 0.02	0.42	59	Total Fe 9.5	327	19	230	0	
Irrigation well	13N/11W-21L1	6-22-53	—	488	7.7	31 / 1.55	21 / 1.73	46 / 2.00	1.0 / 0.03	0.0 / 0.00	267 / 4.38	27 / 0.56	14 / 0.39	0.1 / 0.00	0.1 / 0.00	0.18	33	Total Fe 0.5; Mn 0.00	305	38	164	0	
Domestic well	13N/11W-22H1	6-22-53	—	229	6.7	17 / 0.85	13 / 1.07	10 / 0.44	1.1 / 0.03	0.0 / 0.00	115 / 1.88	9.7 / 0.20	4.8 / 0.14	8.6 / 0.14	0.1 / 0.00	0.02	22	Total Fe 0.1; Mn 0.00	143	18	96	2	
Domestic well	13N/11W-22H2	6-22-53	—	252	6.8	21 / 1.05	12 / 0.99	12 / 0.52	5.4 / 0.14	0.0 / 0.00	148 / 2.43	4.0 / 0.08	5.0 / 0.14	0.0 / 0.00	0.1 / 0.00	0.03	14	Total Fe 0.4; Mn 0.00	146	19	102	0	
Domestic well	13N/11W-30J1	6-22-53	—	335	7.0	20 / 1.00	31 / 2.55	4.5 / 0.20	0.5 / 0.01	0.0 / 0.00	198 / 3.24	13 / 0.27	5.5 / 0.16	2.7 / 0.04	0.0 / 0.00	0.08	24	Total Fe 0.1	199	5	177	15	
Irrigation well	13N/12W-1C1	6-23-53	—	289	6.9	20 / 1.00	19 / 1.56	9.4 / 0.41	0.2 / 0.00	0.0 / 0.00	114 / 1.87	35 / 0.73	6.8 / 0.19	11 / 0.18	0.0 / 0.00	0.10	23	Total Fe 1.8; Mn 0.00	181	14	128	35	
LAYTONVILLE VALLEY																							
Domestic well	21N/14W-19N1	6-3-53	—	101	6.8	6.5 / 0.32	7.2 / 0.59	3.4 / 0.15	0.3 / 0.01	0.0 / 0.00	59 / 0.97	2.4 / 0.05	4.2 / 0.12	0.1 / 0.00	0.0 / 0.00	0.05	13	Total Fe 7.9	66	14	46	0	Small amount of gas present
Domestic well	21N/14W-30K1	11-19-52	—	858	7.8	52 / 2.59	51 / 4.19	62 / 2.70	0.5 / 0.01	0.0 / 0.00	438 / 7.18	32 / 0.67	40 / 1.16	0.9 / 0.01	0.3 / 0.02	0.13	18		472	28	339	0	
Irrigation well	21N/14W-31J1	11-18-52	—	462	7.6	28 / 1.40	26 / 2.[illegible]	34 / 1.48	1.1 / 0.03	0.0 / 0.00	262 / 4.29	2.5 / 0.05	22 / 0.62	0.8 / 0.01	0.0 / 0.00	0.07	0.5		244	29	177	0	
Domestic well	21N/15W-1K1	9-27-53	—	442	7.6	49 / 2.44	20 / 1.64	19 / 0.83	1.3 / 0.03	0.0 / 0.00	272 / 4.46	1.2 / 0.02	14 / 0.40	0.2 / 0.00	0.4 / 0.02	0.07	45	Total Fe 0.10	284	17	204	0	
Domestic well	21N/15W-11B2	11-24-52	—	87.3	6.4	4.4 / 0.22	3.0 / 0.25	11 / 0.48	0.8 / 0.02	0.0 / 0.00	40 / 0.66	0.6 / 0.01	8.5 / 0.24	2.7 / 0.04	0.1 / 0.00	0.10	28		79	50	23	0	
Domestic well	21N/15W-12C1	11-5-52	—	312	7.9	44 / 2.20	4.7 / 0.39	17 / 0.74	0.3 / 0.01	0.0 / 0.00	171 / 2.80	0.4 / 0.01	18 / 0.51	0.6 / 0.01	0.1 / 0.00	0.22	22		191	22	129	0	
Domestic well	21N/15W-12C2	11-5-52	—	608	7.8	49 / 2.45	4.4 / 0.36	73 / 3.17	1.6 / 0.04	0.0 / 0.00	236 / 3.87	4.5 / 0.09	73 / 2.06	1.5 / 0.02	0.0 / 0.00	9.8	5.2		338	53	140	0	
Municipal well	21N/15W-13B1	11-5-52	—	387	7.6	26 / 1.30	18 / 1.48	31 / 1.35	0.6 / 0.02	0.0 / 0.00	208 / 3.41	2.3 / 0.05	23 / 0.65	0.9 / 0.02	0.0 / 0.00	1.0	32		237	33	139	0	
Domestic well	21N/15W-14A1	11-24-52	—	93.2	6.4	4.9 / 0.24	3.3 / 0.27	9.8 / 0.43	0.4 / 0.01	0.0 / 0.00	42 / 0.69	0.4 / 0.01	7.5 / 0.21	2.9 / 0.05	0.0 / 0.00	0.04	28		78	45	26	0	
Domestic well	21N/15W-24A1	6-5-53	—	267	7.1	35 / 1.75	11 / 0.90	5.4 / 0.24	0.7 / 0.02	0.0 / 0.00	158 / 2.59	7.3 / 0.15	3.0 / 0.08	1.7 / 0.03	0.1 / 0.00	0.05	15	Total Fe 0.8	157	8	133	3	

TABLE 3
MINERAL ANALYSES OF GROUND WATER[a]
MENDOCINO COUNTY

Source	Well number M.D.B.&M.	Date sampled	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
										LAYTONVILLE VALLEY (Continued)													
Domestic well	21N/15W-24N1	11-21-52	—	297	7.3	13 / 0.65	8.0 / 0.66	34 / 1.48	1.0 / 0.03	0.0 / 0.00	82 / 1.34	3.0 / 0.06	48 / 1.35	0.8 / 0.01	0.0 / 0.00	0.09	8.8		157	53	65	0	
Domestic well	22N/15W/22E1	11-7-52	—	135	6.8	15 / 0.75	9.1 / 0.75	7.8 / 0.34	0.4 / 0.01	0.0 / 0.00	80 / 1.31	1.8 / 0.04	19 / 0.54	0.2 / 0.00	0.0 / 0.00	0.08	13		106	18	75	9	
Domestic well	22N/15W-35B1	6-3-53	—	85.6	6.8	6.3 / 0.31	4.2 / 0.34	4.1 / 0.18	0.6 / 0.02	0.0 / 0.00	41 / 0.67	2.6 / 0.05	4.5 / 0.13	0.1 / 0.00	0.2 / 0.01	0.07	13	Total Fe 0.6	56	21	33	0	
										LITTLE LAKE VALLEY													
Domestic well	19N/13W-3K1	6-9-53	—	591	7.3	51 / 2.54	35 / 2.88	30 / 1.30	0.8 / 0.02	0.0 / 0.00	392 / 6.42	0.3 / 0.01	8.5 / 0.24	1.0 / 0.02	0.3 / 0.02	1.2	25	Total Fe 2.7	346	10	271	0	
Irrigation well	19N/13W-18H1	6-9-53	64	395	7.5	27 / 1.35	17 / 1.40	31 / 1.35	1.4 / 0.04	0.0 / 0.00	255 / 4.18	0.7 / 0.02	4.0 / 0.11	0.3 / 0.01	0.2 / 0.01	0.17	38	Total Fe 1.7	245	33	137	0	
Domestic well	19N/13W-20A1	6-9-53	—	296	6.9	24 / 1.20	16 / 1.32	11 / 0.48	0.4 / 0.01	0.0 / 0.00	142 / 2.33	7.6 / 0.16	15 / 0.42	9.0 / 0.14	0.1 / 0.00	0.04	17	Total Fe 0.3 Mn 0.09	170	16	126	9	
Domestic well	18N/14W-2P1	9-30-53	—	110	6.7	8.9 / 0.44	2.6 / 0.21	7.8 / 0.34	1.1 / 0.03	0.0 / 0.00	49 / 0.80	2.6 / 0.05	5.5 / 0.15	0.4 / 0.01	0.1 / 0.00	0.12	17		70	33	33	0	
Domestic well	18N/14W-12H1	6-9-53	66	446	7.1	40 / 2.00	12 / 0.99	32 / 1.39	1.2 / 0.03	0.0 / 0.00	154 / 2.52	2.1 / 0.04	62 / 1.75	0.0 / 0.00	0.3 / 0.02	3.8	29	Total Fe 8.3 Mn 0.71	258	32	149	23	
Domestic well	18N/14W-13H1	6-9-53	—	859	7.3	50 / 2.50	49 / 4.03	80 / 3.48	3.3 / 0.08	0.0 / 0.00	564 / 9.24	21 / 0.44	8.5 / 0.24	2.0 / 0.03	0.4 / 0.02	0.41	30	Total Fe 1.3 Mn 0.02	522	34	326	0	
Domestic well	19N/13W-31C1	6-9-53	—	139	6.9	26 / 1.30	5.2 / 0.43	5.2 / 0.23	0.8 / 0.02	0.0 / 0.00	108 / 1.77	5.2 / 0.11	3.0 / 0.08	0.2 / 0.00	0.0 / 0.00	0.05	17	Total Fe 0.2 Mn 0.00	116	11	86	0	
										POTTER VALLEY													
Domestic well	17N/11W-5G1	6-11-53	—	538	6.9	47 / 2.35	31 / 2.55	25 / 1.09	0.6 / 0.02	0.0 / 0.00	284 / 4.65	30 / 0.62	22 / 0.62	0.2 / 0.00	0.1 / 0.00	0.58	18	Total Fe 1.2	314	18	245	12	
Domestic well	17N/11W-6E1	6-11-53	66	240	7.4	24 / 1.20	11 / 0.90	10 / 0.44	0.7 / 0.02	0.0 / 0.00	147 / 2.41	3.9 / 0.08	4.0 / 0.11	0.1 / 0.00	0.0 / 0.00	0.04	22	Total Fe 0.4	148	17	105	0	
Domestic well	17N/11W-8F1	6-11-53	65	282	7.5	28 / 1.40	12 / 0.99	13 / 0.56	0.6 / 0.02	0.0 / 0.00	108 / 1.77	49 / 1.02	5.8 / 0.16	0.1 / 0.00	0.1 / 0.00	0.14	17	Total Fe 0.1	179	19	119	31	
Domestic well	17N/11W-17K1	6-11-53	—	660	7.1	36 / 1.80	62 / 5.10	9.2 / 0.40	0.1 / 0.00	0.0 / 0.00	325 / 5.33	36 / 0.75	24 / 0.68	29 / 0.47	0.0 / 0.00	0.03	37	Total Fe 0.1	395	5	345	76	
Irrigation well	17N/11W-18A2	6-11-53	—	243	7.2	18 / 0.90	15 / 1.23	10 / 0.44	0.6 / 0.02	0.0 / 0.00	152 / 2.49	0.2 / 0.00	5.5 / 0.16	0.3 / 0.00	0.0 / 0.00	0.61	26	Total Fe 0.6	150	17	107	0	

TABLE 3

MINERAL ANALYSES OF GROUND WATER[a]

MENDOCINO COUNTY

Source	Well number M.D.B.&M.	Date sampled	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
POTTER VALLEY (Continued)																							
Domestic well	17N/11W-19N1	6-11-53	—	316	6.9	33 1.65	17 1.40	7.2 0.31	0.7 0.02	0.0 0.00	167 2.74	18 0.38	9.0 0.25	1.9 0.03	0.0 0.00	0.00	16	Total Fe 0.0	185	9	152	15	
Domestic well	17N/11W-33D1	9-23-52	64	1,680	7.9	93 4.64	63 5.18	218 9.48	9.6 0.25	0.0 0.00	1,100 18.03	0.9 0.02	58 1.64	0.2 0.00	0.1 0.00	1.0	35		1,020	48	491	0	
Domestic well	17N/11W-34N1	6-11-53	—	301	6.9	29 1.45	16 1.32	11 0.48	0.2 0.00	0.0 0.00	166 2.72	14 0.29	7.0 0.20	0.5 0.01	0.1 0.00	0.04	27	Total Fe 0.2	187	15	138	2	
Domestic well	17N/12W-13E1	6-11-53	64	243	6.6	18 0.90	15 1.23	6.5 0.28	1.3 0.03	0.0 0.00	104 1.70	8.5 0.18	8.0 0.23	21 0.34	0.0 0.00	0.12	11	Total Fe 0.4	140	12	107	21	
ROUND VALLEY																							
Domestic well	22N/12W-5L1	10-30-52	—	319	7.5	30 1.50	17 1.40	16 0.70	0.6 0.02	0.0 0.00	202 3.31	1.0 0.02	3.0 0.08	1.6 0.03	0.0 0.00	0.06	29		198	19	145	0	
Domestic well	22N/12W-7K4	5-19-53	—	243	7.7	14 0.70	17 1.40	13 0.56	0.4 0.01	0.0 0.00	135 2.21	8.9 0.18	7.8 0.22	1.0 0.02	0.1 0.00	0.13	20	Total Fe 2.0	149	21	105	0	
Irrigation well	22N/12W-8N1	11-12-52	—	224	7.5	15 0.75	12 0.99	15 0.65	0.6 0.02	0.0 0.00	114 1.87	11 0.23	7.8 0.22	1.7 0.03	0.0 0.00	0.00	12		131	27	87	0	
Domestic well	22N/12W-19M1	10-30-52	—	442	7.5	30 1.50	38 3.12	10 0.44	0.3 0.01	0.0 0.00	258 4.23	27 0.56	6.0 0.17	2.3 0.04	0.0 0.00	0.24	26		267	9	231	20	
Domestic well	22N/12W-21A1	11-12-52	—	691	7.8	27 1.35	29 2.33	93 4.04	0.8 0.02	0.0 0.00	460 7.54	1.2 0.02	5.0 0.14	8.9 0.14	0.0 0.00	0.18	0.0		392	52	186	0	
Industrial well	22N/13W-1E1	10-30-52	—	249	7.7	27 1.35	10 0.82	8.7 0.38	1.0 0.03	0.0 0.00	134 2.20	14 0.30	5.0 0.14	0.7 0.01	0.0 0.00	0.08	9.2		142	15	108	0	
Domestic well	22N/13W-1J1	10-30-52	—	209	7.6	22 1.10	9.5 0.78	6.9 0.30	0.7 0.02	0.0 0.00	114 1.87	11 0.23	3.2 0.09	0.9 0.02	0.0 0.00	0.11	6.0		116	14	94	1	
Domestic well	23N/12W-28N1	6-4-53	—	266	7.9	27 1.35	12 0.99	13 0.56	0.7 0.02	0.0 0.00	157 2.57	8.4 0.18	3.5 0.10	2.9 0.05	0.1 0.00	0.14	15	Total Fe 7.4	160	19	117	0	
Domestic well	23N/12W-29P2	6-4-53	—	433	8.3	52 2.60	17 1.40	19 0.83	0.6 0.02	0.0 0.00	290 4.75	0.2 0.00	3.8 0.11	0.4 0.01	0.2 0.01	0.18	33	Total Fe 3.9	269	17	200	0	
Irrigation well	23N/12W-31N1	4-3-52	57	246	8.3	26 1.30	13 1.07	7.2 0.31	0.7 0.02	0.0 0.00	146 2.39	9.4 0.20	3.0 0.08	0.2 0.00	0.0 0.00	0.04	17		148	12	118	0	
Domestic well	23N/12W-33L1	6-4-53	--	613	8.3	61 3.04	36 2.96	31 1.35	0.5 0.01	0.0 0.00	424 6.95	0.8 0.02	4.5 0.13	1.2 0.02	0.6 0.03	0.14	30	Total Fe 1.6	374	18	300	0	
Domestic well	23N/13W-25A1	11-13-52	—	328	7.8	40 2.00	13 1.07	12 0.52	0.8 0.02	0.0 0.00	210 3.44	0.9 0.02	2.8 0.08	2.0 0.03	0.0 0.00	0.09	24		199	14	153	0	

TABLE 3
MINERAL ANALYSES OF GROUND WATER[a]
MENDOCINO COUNTY

Source	Well number M.D.B.&M.	Date sampled	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
											ROUND VALLEY (Continued)												
Domestic Well	23N/13W-35Q1	10-30-52	—	256	7.2	30 / 1.50	9.5 / 0.78	13 / 0.56	0.5 / 0.01	0.0 / 0.00	156 / 2.59	5.8 / 0.12	2.5 / 0.07	0.5 / 0.01	0.0 / 0.00	0.00	8.5		148	20	114	0	
											UKIAH VALLEY												
Domestic well	14N/12W-5K1	5-12-53	—	759	7.3	58 / 2.89	31 / 2.55	41 / 1.78	2.0 / 0.05	0.0 / 0.00	357 / 5.85	64 / 1.33	5.2 / 0.15	0.7 / 0.01	0.3 / 0.02	---	23	Total Fe 2.2	401	24	272	0	
Domestic well	14N/12W-11N1	8-11-53	—	263	7.1	17 / 0.85	18 / 1.48	8.2 / 0.36	1.4 / 0.04	0.0 / 0.00	131 / 2.15	22 / 0.46	6.5 / 0.18	3.4 / 0.06	0.1 / 0.00	0.07	23	Total Fe 0.0; Mn 0.02	164	13	116	9	
Domestic well	14N/12W-16A1	6-12-53	—	389	7.3	30 / 1.50	25 / 2.06	14 / 0.61	0.9 / 0.02	0.0 / 0.00	228 / 3.74	12 / 0.25	5.2 / 0.15	1.8 / 0.03	0.1 / 0.00	0.21	21	Total Fe 0.2	222	15	178	0	
Domestic well	14N/12W-25R1	8-11-53	—	309	7.9	35 / 1.75	23 / 1.89	11 / 0.48	0.9 / 0.02	0.0 / 0.00	208 / 3.41	23 / 0.48	7.8 / 0.22	0.4 / 0.01	0.1 / 0.00	0.11	22	Total Fe 0.2; Mn 0.03	226	12	132	11	
Domestic well	14N/12W-26K1	3-13-53	—	1,000	7.7	40 / 2.00	25 / 2.00	135 / 5.90	---	10 / 0.30	265 / 4.40	---	265 / 7.50	---	---	43.6	---		---	60	—	—	c
Domestic well	14N/12W-26K1	3-13-53	—	1,120	7.4	45 / 2.10	25 / 2.00	170 / 7.40	---	---	315 / 5.10	---	300 / 8.50	---	---	39.2	---		---	64	—	—	c
Domestic well	15N/12W-8D1	8-11-53	—	381	7.5	29 / 1.45	20 / 1.64	25 / 1.09	0.8 / 0.02	0.0 / 0.00	227 / 3.72	11 / 0.23	8.5 / 0.24	1.0 / 0.02	0.2 / 0.01	0.11	28	Total Fe 0.1; Mn 0.37	235	26	155	0	
Domestic well	15N/12W-14C1	12- --50	—	610	7.7	25 / 1.20	10 / 0.90	115 / 5.10	---	---	375 / 6.20	10 / 0.20	30 / 0.80	---	---	8.40	---		---	71	105	0	c
Municipal well	15N/12W-16E1	7-6-50	—	---	6.8	21 / 1.06	12 / 1.02	5.5 / 0.24	---	0.0 / 0.00	105 / 1.72	0.0 / 0.00	8.1 / 0.23	0.9 / 0.01	0.0 / 0.00	---	---	Fe,Mn 0.0	132[d]	10	104	18	e
Municipal well	15N/12W-16E1	4-30-53	55	328	7.0	32 / 1.60	16 / 1.32	11 / 0.48	1.2 / 0.03	0.0 / 0.00	151 / 2.48	18 / 0.38	18 / 0.51	2.8 / 0.04	0.2 / 0.01	0.11	15		188	14	146	22	
Municipal well	15N/12W-16Q1	7-6-50	—	---	7.7	15 / 0.75	17 / 1.40	0.0 / 0.00	---	0.0 / 0.00	95 / 1.56	0.0 / 0.00	5.1 / 0.14	2.6 / 0.04	0.0 / 0.00	---	---		149[d]	0	106	28	e
Municipal well	15N/12W-22D1	12- --50	—	550	7.3	40 / 2.00	20 / 1.64	55 / 2.39	---	---	320 / 5.30	10 / 0.20	25 / 0.70	---	---	6.05	---		---	39	190	0	c
Municipal well	15N/12W-22D2	12- --50	—	100	8.0	10 / 0.50	20 / 1.80	10 / 0.30	---	---	65 / 1.10	55 / 1.20	10 / 0.30	---	---	0.24	---		---	11	115	60	
Domestic well	15N/12W-27K1	4-29-53	57	339	6.7	47 / 2.35	8.7 / 0.72	11 / 0.48	0.9 / 0.02	0.0 / 0.00	172 / 2.82	18 / 0.38	4.8 / 0.14	10 / 0.16	0.1 / 0.00	0.15	19		204	13	153	12	
Domestic well	15N/12W-35D1	5-13-53	—	365	6.8	33 / 1.65	14 / 1.15	25 / 1.09	0.5 / 0.01	0.0 / 0.00	200 / 3.28	8.1 / 0.17	16 / 0.45	0.5 / 0.01	0.1 / 0.00	0.16	31	Total Fe 7.3	227	28	140	0	

TABLE 3

MINERAL ANALYSES OF GROUND WATER[a]

MENDOCINO COUNTY

Source	Well number M.D.B.&M.	Date sampled	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total[b] dissolved solids in ppm	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
						UKIAH VALLEY (Continued)																	
Domestic well	16N/12W-5D1	8-12-53	—	357	7.4	23 1.15	20 1.64	23 1.00	0.7 0.02	0.0 0.00	187 3.06	3.0 0.06	25 0.70	0.6 0.01	0.2	0.02	33	Total Fe 0.0; Mn 0.31	221	26	140	0	
Domestic well	16N/12W-7L1	8-12-53	—	244	7.4	25 1.25	11 0.91	9.4 0.41	1.0 0.03	0.0 0.00	139 2.28	10 0.21	6.0 0.17	0.3 0.00	0.1 0.00	0.11	17	Total Fe 0.2	148	16	108	0	
Domestic well	16N/12W-9Q1	5-14-53	—	424	7.8	28 1.40	18 1.48	38 1.65	0.8 0.02	0.0 0.00	260 4.26	7.7 0.16	10 0.28	0.2 0.00	0.4 0.02	0.10	28	Total Fe 0.2	259	36	144	0	
Domestic well	16N/12W-22H1	8-12-53	—	207	7.3	13 0.65	11 0.90	10 0.44	0.8 0.02	0.0 0.00	61 1.00	2.6 0.05	12 0.34	39 0.63	0.1 0.00	0.01	20	Total Fe 0.4	138	22	78	28	
Irrigation well	16N/12W-26D1	5-14-53	—	247	6.8	24 1.20	12 0.99	9.6 0.42	0.7 0.02	0.0 0.00	122 2.00	18 0.38	6.2 0.18	3.0 0.05	0.1 0.00	0.14	17	Total Fe 1.5	151	16	109	9	
Domestic well	16N/13W-1J1	8-5-53	—	252	6.6	19 0.95	15 1.23	10 0.44	1.2 0.03	0.0 0.00	118 1.93	16 0.33	9.8 0.28	1.7 0.03	0.0 0.00	0.06	20	Total Fe 4.5	151	16	109	12	
Domestic well	17N/12W-18A1	8-12-53	—	1,810	7.4	63 3.14	8.0 0.66	292 12.70	1.2 0.03	0.0 0.00	238 3.90	0.7 0.01	466 13.14	1.5 0.02	0.8 0.04	55	17	Fe 11	1,030	77	190	0	
Domestic well	17N/12W-28M1	8-12-53	—	201	6.5	16 0.80	10 0.82	9.4 0.41	0.5 0.01	0.0 0.00	83 1.36	8.0 0.17	7.5 0.21	14 0.23	0.1 0.00	0.00	32	Fe 0.1	138	20	81	13	
						FORT BRAGG TERRACE AND CONTIGUOUS AREAS																	
Spring	17N/16W-28F1	7-7-53	—	8,180	7.5	74 3.69	169 13.90	2,180 94.79	44 1.13	0.0 0.00	6,120 100.30	2.2 0.05	330 9.31	19 0.31	0.4 0.02	205	74		6,110	84	880	0	
Domestic well	17N/17W-19P1	8-19-53	—	634	7.3	57 2.84	8.0 0.66	81 3.52	1.9 0.05	0.0 0.00	270 4.42	34 0.71	68 1.92	0.7 0.01	0.0 0.00	0.00	20	Total Fe 0.9	414	50	175	0	
Domestic well	17N/17W-31K1	8-19-53	—	140	7.0	5.1 0.25	2.5 0.21	17 0.74	0.4 0.01	0.0 0.00	23 0.38	5.3 0.11	26 0.73	1.9 0.03	0.0 0.00	0.00	18	Total Fe 0.2	88	61	23	4	
Domestic well	19N/17W-15N1	6-17-53	—	137	6.9	3.8 0.19	3.1 0.26	16 0.70	0.8 0.02	0.0 0.00	17 0.28	14 0.29	25 0.70	0.3 0.00	0.0 0.00	0.01	22	Total Fe 3.5; Fe 0.8	94	58	24	10	
Auger test hole	19N/17W-19R1	6-4-52	—	1,560	7.1	96 4.79	35 2.88	175 7.61	2.0 0.05	0.0 0.00	574 9.41	0.6 0.01	230 6.49	0.0 0.00	0.3 0.02	35	33	Al 1.2	891	40	384	0	
Domestic well	19N/17W-19R2	8-19-53	—	409	5.8	12 0.60	12 0.99	46 2.00	3.0 0.08	0.0 0.00	50 0.82	6.7 0.14	93 2.62	0.3 0.00	0.0 0.00	0.06	11	Total Fe 0.2	209	55	79	38	
Spring	21N/17W-6M1	6-10-53	—	206	7.5	7.6 0.38	4.6 0.38	24 1.04	1.6 0.04	0.0 0.00	41 0.67	9.4 0.20	32 0.90	0.8 0.01	0.2 0.01	0.01	21	Total Fe 0.5	121	57	38	4	
Domestic well	21N/17W-29E1	6-11-53	—	229	8.7	21 1.05	2.8 0.23	19 0.83	1.3 0.03	0.0 0.00	65 1.06	4.6 0.10	34 0.96	2.2 0.04	0.0 0.00	0.00	10	Total Fe 0.1	127	39	64	11	

TABLE 3

MINERAL ANALYSES OF GROUND WATER[a]

MENDOCINO COUNTY

Source	Well number M.D.B.&M.	Date sampled	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
						FORT BRAGG TERRACE AND CONTIGUOUS AREA (Continued)																	
Domestic well	21N/17W-29N1	6-11-53	—	392	7.0	26 / 1.30	11 / 0.90	36 / 1.56	1.4 / 0.04	0.0 / 0.00	100 / 1.64	11 / 0.23	66 / 1.86	1.4 / 0.02	0.1 / 0.00	0.23	22	Total Fe 1.5	225	41	110	28	
						POINT ARENA TERRACE AND CONTIGUOUS AREAS																	
Domestic well	11N/15W-22C1	8-19-53	—	201	7.0	19 / 0.95	5.9 / 0.48	13 / 0.56	0.4 / 0.01	0.0 / 0.00	73 / 1.20	11 / 0.23	21 / 0.59	0.2 / 0.00	0.0 / 0.00	0.01	25	Total Fe 0.9	132	28	72	12	
Domestic well	11N/16W-13B1	8-19-53	—	1,920	6.8	132 / 6.59	58 / 4.77	150 / 6.52	2.1 / 0.05	0.0 / 0.00	139 / 2.28	42 / 0.87	530 / 14.95	0.3 / 0.01	0.0 / 0.00	0.00	25	Total Fe 7.8	1,010	36	568	454	
Domestic well	13N/17W-36M1	8-20-53	—	564	7.3	27 / 1.35	8.8 / 0.72	84 / 3.65	1.9 / 0.05	0.0 / 0.00	228 / 3.74	17 / 0.35	56 / 1.58	2.2 / 0.04	0.3 / 0.02	0.05	17	Total Fe 0.1	326	63	104	0	
Irrigation well	15N/16W-19L1	7-14-53	--	97.6	7.4	2.1 / 0.10	2.4 / 0.20	11 / 0.48	0.5 / 0.01	0.0 / 0.00	16 / 0.26	3.7 / 0.08	17 / 0.48	0.2 / 0.00	0.0 / 0.00	0.00	25	Total Fe 0.3	70	60	15	2	
Domestic well	15N/16W-32H1	7-24-53	—	157	7.8	9.8 / 0.49	3.3 / 0.27	19 / 0.83	0.4 / 0.01	0.0 / 0.00	79 / 1.30	11 / 0.23	4.8 / 0.14	0.2 / 0.00	0.0 / 0.00	0.16	32	Total Fe 0.0	119	52	38	0	
						MISCELLANEOUS AREAS AND MINOR VALLEYS																	
Domestic well	12N/11W-19D1	10-1-53	—	332	7.2	28 / 1.40	20 / 1.64	14 / 0.61	1.1 / 0.03	0.0 / 0.00	188 / 3.08	12 / 0.25	8.0 / 0.23	0.6 / 0.01	0.0 / 0.00	0.15	19		195	17	152	0	
Spring	13N/13W-11M1	7-7-52	64	114	6.2	6.6 / 0.33	4.5 / 0.37	12 / 0.52	0.5 / 0.01	0.0 / 0.00	55 / 0.90	5.8 / 0.12	4.7 / 0.13	0.5 / 0.01	0.1 / 0.00	0.05	31		93	42	35	0	
Domestic well	16N/16W-12B1	9-29-53	—	399	7.8	45 / 2.25	14 / 1.15	18 / 0.78	1.0 / 0.03	0.0 / 0.00	223 / 3.66	9.5 / 0.20	14 / 0.40	0.1 / 0.00	0.1 / 0.00	0.16	22		234	19	170	0	
Spring	17N/16W-35R1	9-29-53	—	2,560	6.8	243 / 12.13	109 / 8.96	265 / 11.52	3.0 / 0.03	0.0 / 0.00	1,850 / 30.32	1.7 / 0.04	62 / 1.75	0.2 / 0.00	0.5 / 0.03	23	115		1,730	35	1,050	0	
Irrigation well	19N/12W-31Q1	9-1-53	57	119	6.9	7.6 / 0.38	5.3 / 0.44	8.0 / 0.35	0.9 / 0.02	0.0 / 0.00	50 / 0.82	4.7 / 0.10	10 / 0.28	0.7 / 0.01	0.1 / 0.00	0.41	13		75	29	41	0	
Domestic well	21N/12W-34M1	7-21-53	63	236	7.5	24 / 1.20	13 / 1.07	5.2 / 0.23	0.8 / 0.02	0.0 / 0.00	136 / 2.23	11 / 0.23	3.0 / 0.08	0.4 / 0.01	0.1 / 0.00	0.02	15		140	9	113	2	
Domestic well	21N/16W-22K1	8-26-53	--	122	7.2	11 / 0.55	3.1 / 0.26	9.2 / 0.40	0.5 / 0.01	0.0 / 0.00	59 / 0.97	1.4 / 0.03	8.5 / 0.24	0.2 / 0.00	0.0 / 0.00	1.2	16	Total Fe 0.17	80	33	40	0	
Domestic well	21N/16W-26C1	8-26-53	--	294	7.8	44 / 2.20	6.6 / 0.54	10 / 0.44	0.5 / 0.01	0.0 / 0.00	183 / 3.00	5.3 / 0.11	2.8 / 0.08	0.1 / 0.00	0.0 / 0.00	0.04	20	Total Fe 0.09	179	14	137	0	
Spring	22N/18W-24F1	6-10-53	--	181	7.6	14 / 0.70	5.0 / 0.41	14 / 0.61	1.4 / 0.04	0.0 / 0.00	68 / 1.11	9.4 / 0.20	18 / 0.51	0.5 / 0.01	0.3 / 0.02	0.02	22	Fe 0.2	118	35	56	0	

TABLE 3

MINERAL ANALYSES OF GROUND WATER[a]

MENDOCINO COUNTY

Source	Well number M.D.B.&M.	Date sampled	Temp. in °F	Specific conductance (micromhos at 25°C)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents	Total[b] dissolved solids in ppm	Percent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
						MISCELLANEOUS AREAS AND MINOR VALLEYS (Continued)																	
Spring	22N/18W-36R1	6-10-53	—	170	7.4	10 / 0.50	4.3 / 0.35	16 / 0.70	1.6 / 0.04	0.0 / 0.00	54 / 0.88	6.3 / 0.13	22 / 0.62	0.7 / 0.01	0.1 / 0.00	0.04	21	Total Fe 0.2	109	44	43	0	
Domestic well	23N/12W-26E1	10-6-53	—	348	7.2	20 / 1.00	19 / 1.56	20 / 0.87	0.6 / 0.02	0.0 / 0.00	138 / 2.26	8.8 / 0.18	25 / 0.70	16 / 0.26	0.1 / 0.00	0.35	17		194	25	128	15	
Irrigation well	23N/17W-10A1	8-24-53	—	206	6.9	20 / 1.00	9.3 / 0.77	8.6 / 0.37	0.6 / 0.02	0.0 / 0.00	114 / 1.87	3.5 / 0.07	6.8 / 0.19	3.2 / 0.05	0.0 / 0.00	0.05	22	Total Fe 0.06	130	17	88	0	
Domestic well	23N/17W-11E1	8-24-53	—	318	7.0	17 / 0.85	24 / 1.97	15 / 0.65	0.5 / 0.01	0.0 / 0.00	204 / 3.34	1.6 / 0.03	3.2 / 0.09	0.6 / 0.01	0.1 / 0.00	0.44	29	Total Fe 1.9	192	19	141	0	
Domestic well	24N/17W-6D1	8-26-53	—	81.4	7.1	7.2 / 0.36	3.1 / 0.26	5.8 / 0.25	0.2 / 0.00	0.0 / 0.00	46 / 0.75	1.6 / 0.03	2.8 / 0.08	1.5 / 0.02	0.0 / 0.00	0.03	20	Total Fe 0.56	65	29	31	0	

a - Unless otherwise noted, analyses are by United States Geological Survey, Quality of Water Branch, Sacramento Laboratory.

b - Unless otherwise noted, calculated from analyzed constituents.

c - Analysis by University of California.

d - Gravimetric determination.

e - Analysis by Bureau of Sanitary Engineering, California Department of Public Health.

TABLE 4

RESULTS OF BACTERIOLOGICAL
EXAMINATIONS OF GROUND WATER[a]
MENDOCINO COUNTY

Location	Field rating	Date sampled	Coliform[b] MPN/100 ml.
ANDERSON VALLEY			
0.5 mile northwest of Boonville	Fair	9-2-53	2-
0.25 mile west of Boonville	Fair	9-2-53	240+
1.0 mile south of Boonville	Fair	9-2-53	2-
1.0 mile west of Boonville	Poor	9-2-53	1.8- [c]
0.25 mile south of Boonville	Fair	9-2-53	2-
1.0 mile east of Boonville	Poor	9-2-53	130 [c]
1.0 mile south of Boonville	Fair	9-2-53	2-
At Philo	Fair	9-2-53	2-
At Philo	Poor	9-2-53	23 [c]
At Philo	Good	9-2-53	240
At Philo	Fair	9-2-53	2-
0.5 mile south of Philo	Good	9-2-53	2-
1.0 mile southeast of Philo	Good	9-2-53	2-
1.5 miles southeast of Philo	Fair	9-2-53	2-
3.0 miles southeast of Philo	Fair	9-2-53	5
3.5 miles southeast of Philo	Fair	9-2-53	2-
1.0 mile northwest of Boonville	Poor	9-2-53	1.8- [c]
1.0 mile northwest of Boonville	Good	9-2-53	2-
1.5 miles northwest of Boonville	Fair	9-2-53	2-
0.75 mile northwest of Boonville	Good	9-2-53	2-
4.0 miles northwest of Philo	Good	9-2-53	2-
3.0 miles northwest of Philo	Poor	9-2-53	1.8- [c]
1.0 mile northwest of Philo	Fair	9-2-53	2-
SANEL VALLEY			
5.0 miles southwest of Hopland	Good	9-4-53	2-
2.0 miles north of Hopland	Good	9-4-53	2-
1.0 mile north of Hopland	Fair	9-4-53	2.2
At Hopland	Poor	9-4-53	1.8- [c]
At Hopland	Poor	9-4-53	6.8 [c]
At east Hopland	Good	9-4-53	2-
At east Hopland	Good	9-4-53	2-
At east Hopland	Poor	9-4-53	7.8 [c]
At east Hopland	Poor	9-4-53	140
3.0 miles east of Hopland	Fair	9-4-53	240
1.0 mile south of Hopland	Good	9-4-53	240
1.0 mile south of Hopland	Fair	9-4-53	2-
1.0 mile south of Hopland	Good	9-4-53	2-
1.0 mile west of Hopland	Fair	9-4-53	240
1.0 mile west of Hopland	Fair	9-4-53	8.8
LAYTONVILLE VALLEY			
2.0 miles south of Laytonville	Poor	8-31-53	2.2
3.0 miles south of Laytonville	Fair	8-31-53	2.2
3.0 miles south of Laytonville	Fair	8-31-53	240
4.0 miles south of Laytonville	Poor	8-31-53	240
1.0 mile north of Laytonville	Poor	8-31-53	38

TABLE 4

RESULTS OF BACTERIOLOGICAL EXAMINATIONS OF GROUND WATER[a]

MENDOCINO COUNTY

Location	Field rating	Date sampled	Coliform[b] MPN/100 ml.
LAYTONVILLE VALLEY (Continued)			
2.0 miles west of Laytonville	Fair	8-31-53	2-
1.0 mile west of Laytonville	Fair	8-31-53	2.2
At Laytonville	Poor	8-31-53	2-
At Laytonville	Good	8-31-53	2.2
At Laytonville	Fair	8-31-53	2-
1.0 mile southwest of Laytonville	Fair	8-31-53	2-
1.0 mile southwest of Laytonville	Poor	8-31-53	240+
2.0 miles south of Laytonville	Fair	8-31-53	240+
2.0 miles south of Laytonville	Poor	8-31-53	240
2.0 miles southwest of Laytonville	Fair	8-31-53	38
4.5 miles north of Laytonville	Good	8-31-53	38
2.0 miles north of Laytonville	Poor	8-31-53	5
LITTLE LAKE VALLEY			
1.0 mile northeast of Willits	Fair	8-31-53	240+
1.0 mile northeast of Willits	Poor	8-31-53	240+
1.5 miles northeast of Willits	Fair	8-31-53	240
1.5 miles northeast of Willits	Fair	8-31-53	2-
2.0 miles east of Willits	Poor	8-31-53	240
2.0 miles east of Willits	Fair	8-31-53	96
1.0 mile east of Willits	Poor	8-31-53	12
1.0 mile east of Willits	Fair	8-31-53	2-
1.0 mile east of Willits	Fair	8-31-53	240
At Willits	Fair	8-31-53	8.8
1.0 mile southeast of Willits	Fair	8-31-53	2.2
1.0 mile southeast of Willits	Poor	8-31-53	240
2.0 miles south of Willits	Good	8-31-53	2-
2.0 miles south of Willits	Fair	8-31-53	8.8
2.0 miles north of Willits	Poor	8-31-53	240
1.0 mile north of Willits	Good	8-31-53	2-
1.0 mile north of Willits	Poor	8-31-53	240+
0.5 mile west of Willits	Fair	8-31-53	240+
1.5 miles west of Willits	Fair	8-31-53	12
3.0 miles north of Willits	Poor	8-31-53	240
POTTER VALLEY			
4.0 miles south of Potter Valley	Fair	9-2-53	2-
2.0 miles north of Potter Valley	Fair	9-2-53	15
1.5 miles north of Potter Valley	Fair	9-2-53	240+
1.0 mile north of Potter Valley	Poor	9-2-53	1600 c
At Potter Valley	Good	9-2-53	38
At Potter Valley	Poor	9-2-53	7.8 c
At Potter Valley	Poor	9-2-53	2 c
1.5 miles southwest of Potter Valley	Fair	9-2-53	240
1.0 mile south of Potter Valley	Poor	9-2-53	4.5 c
1.0 mile south of Potter Valley	Good	9-2-53	2 c
1.0 mile south of Potter Valley	Poor	9-2-53	1.8- c
2.0 miles southeast of Potter Valley	Poor	9-2-53	79 c
2.0 miles south of Potter Valley	Fair	9-2-53	240+
2.5 miles south of Potter Valley	Poor	9-2-53	17 c

TABLE 4

RESULTS OF BACTERIOLOGICAL EXAMINATIONS OF GROUND WATER[a]

MENDOCINO COUNTY

Location	Field rating	Date sampled	Coliform[b] MPN/100 ml.
POTTER VALLEY (Continued)			
3.0 miles south of Potter Valley	Fair	9-2-53	2.2
2.0 miles northwest of Potter Valley	Poor	9-2-53	540 c
ROUND VALLEY			
2.0 miles east of Covelo	Fair	9-3-53	2-
1.0 mile south of Covelo	Fair	9-3-53	2-
3.0 miles southeast of Covelo	Fair	9-3-53	2-
3.0 miles south of Covelo	Good	9-3-53	2-
3.0 miles south of Covelo	Good	9-3-53	2-
3.0 miles southeast of Covelo	Poor	9-3-53	1.8- c
3.0 miles southeast of Covelo	Fair	9-3-53	38
At Covelo	Good	9-3-53	2-
At Covelo	Poor	9-3-53	1.8- c
At Covelo	Fair	9-3-53	38
At Covelo	Fair	9-3-53	2-
At Covelo	Poor	9-3-53	1.8- c
At Covelo	Poor	9-3-53	1.8- c
At Covelo	Fair	9-3-53	2-
At Covelo	Fair	9-3-53	1.8- c
1.0 mile south of Covelo	Good	9-3-53	2- c
2.0 miles northeast of Covelo	Fair	9-3-53	2-
2.0 miles north of Covelo	Good	9-3-53	2-
1.5 miles northeast of Covelo	Poor	9-3-53	1.8- c
2.5 miles northeast of Covelo	Poor	9-3-53	1.8- c
2.0 miles north of Covelo	Fair	9-3-53	240+
2.0 miles north of Covelo	Poor	9-3-53	1.8- c
1.0 mile north of Covelo	Fair	9-3-53	2-
0.5 mile north of Covelo	Poor	9-3-53	1.8- c
UKIAH VALLEY			
3.0 miles south of Ukiah	Poor	9-4-53	1.8- c
3.5 miles south of Ukiah	Good	9-4-53	2-
3.0 miles south of Ukiah	Fair	9-4-53	2-
3.0 miles south of Ukiah	Fair	9-4-53	2-
3.0 miles south of Ukiah	Fair	9-4-53	2.2
4.0 miles south of Ukiah	Poor	9-4-53	1600+ c
7.0 miles south of Ukiah	Fair	9-4-53	2-
2.0 miles north of Ukiah	Fair	9-4-53	240+
2.0 miles north of Ukiah	Good	9-4-53	240+
1.5 miles north of Ukiah	Good	9-4-53	240+
1.5 miles northeast of Ukiah	Fair	9-4-53	240+
At Ukiah	Fair	9-4-53	240+

TABLE 4

RESULTS OF BACTERIOLOGICAL EXAMINATIONS OF GROUND WATER[a]

MENDOCINO COUNTY

Location	Field rating	Date sampled	Coliform[b] MPN/100 ml.
UKIAH VALLEY (Continued)			
At Ukiah	Fair	9-4-53	2.2
1.0 mile east of Ukiah	Poor	9-4-53	130 c
1.0 mile south of Ukiah	Poor	9-4-53	1.8- c
1.0 mile south of Ukiah	Good	9-4-53	2-
1.0 mile southeast of Ukiah	Fair	9-4-53	2-
3.0 miles north of Calpella	Fair	8-31-53	2-
3.0 miles north of Calpella	Fair	8-31-53	240
2.5 miles northwest of Calpella	Good	8-31-53	2.2
2.5 miles northwest of Calpella	Poor	8-31-53	5
1.5 miles north of Calpella	Poor	8-31-53	2-
1.0 mile north of Calpella	Good	8-31-53	2-
1.0 mile east of Calpella	Good	8-31-53	2-
0.5 mile east of Calpella	Poor	8-31-53	240
At Calpella	Fair	8-31-53	240+
1.0 mile south of Calpella	Fair	8-31-53	240+
1.0 mile east of Calpella	Poor	8-31-53	240
3.0 miles north of Ukiah	Fair	8-31-53	38
6.0 miles north of Calpella	Fair	8-31-53	240
5.0 miles north of Calpella	Poor	8-31-53	240
3.0 miles north of Calpella	Good	8-31-53	2.2
FORT BRAGG			
0.5 mile north of Little River	Good	9-1-53	15
2.0 miles south of Little River	Good	9-1-53	15
1.5 miles north of Mendocino	Good	9-1-53	2-
1.0 mile north of Mendocino	Poor	9-1-53	2-
At Mendocino	Good	9-1-53	2-
At Mendocino	Fair	9-1-53	2-
1.5 miles south of Mendocino	Good	9-1-53	2-
At Caspar	Fair	9-1-53	15
At Caspar	Good	9-1-53	2-
1.0 mile south of Caspar	Fair	9-1-53	240+
1.5 miles south of Caspar	Fair	9-1-53	4.4
At Fort Bragg	Fair	9-1-53	2-
At Fort Bragg	Fair	9-1-53	2-
1.5 miles north of Fort Bragg	Fair	9-1-53	2-
2.5 miles south of Noyo	Fair	9-1-53	15
1.0 mile south of Noyo	Good	9-1-53	2-
2.0 miles north of Casper	Good	9-1-53	2-
1.0 mile north of Inglenook	Poor	9-1-53	1.8- c
0.5 mile north of Inglenook	Poor	9-1-53	1.8- c
3.0 miles north of Fort Bragg	Good	9-1-53	2-
3.0 miles north of Fort Bragg	Fair	9-1-53	2-
3.0 miles north of Fort Bragg	Fair	9-1-53	8.8
2.0 miles north of Fort Bragg	Good	9-1-53	38
1.0 mile north of Fort Bragg	Poor	9-1-53	13 c
2.5 miles north of Inglenook	Fair	9-1-53	2-

TABLE 4

RESULTS OF BACTERIOLOGICAL
EXAMINATIONS OF GROUND WATER[a]
MENDOCINO COUNTY

Location	Field rating	Date sampled	Coliform[b] MPN/100 ml.
FORT BRAGG (Continued)			
1.0 mile north of Westport	Good	9-1-53	15
0.5 mile north of Westport	Good	9-1-53	2-
POINT ARENA			
1.0 mile north of Gualala	Poor	9-1-53	2 c
0.5 mile south of Gualala	Fair	9-1-53	2-
2.0 miles northwest of Anchor Bay Settlement	Good	9-1-53	2-
3.0 miles northwest of Anchor Bay Settlement	Fair	9-1-53	2-
1.5 miles north of Point Arena	Poor	9-1-53	21 c
1.0 mile north of Point Arena	Fair	9-1-53	2-
At Point Arena	Good	9-1-53	2-
At Point Arena	Fair	9-1-53	2-
At Manchester	Good	9-1-53	2-
1.0 mile northwest of Elk	Fair	9-1-53	240
At Elk	Fair	9-1-53	2-

a - Analyses of Division of Water Resources, Mobile Laboratory

b - Unless otherwise noted, a series of five tubes of 10 ml. dilution, one tube 1 ml. dilution and one tube 0.1 ml. dilution was used.

c - A series of five tubes of 10 ml. dilution, five tubes of 1 ml. dilution, and five tubes of 0.1 dilution was used.

APPENDIX B

SUMMARY OF WELL DRILLERS' INTERVIEWS

SUMMARY OF WELL DRILLERS' INTERVIEWS

Interviews were conducted with sixteen water well drillers currently operating or known to have operated in Mendocino County. The purpose was to determine their present construction practices and materials and to obtain their recommendations for materials and methods necessary to insure reasonable protection of ground water quality. The questions which were asked and a composite of the replies are presented in this appendix.

(1) What is the minimum distance you would recommend wells be located from the following: Sewer lines, septic tanks, privies, and cesspools?

Eleven drillers recommended a minimum of 50 feet; one recommended 75 feet from cesspools and 100 feet from barn or chicken yards, otherwise a minimum of 50 feet; and four recommended a minimum of 75 to 100 feet.

(2) Do you locate wells with respect to topographic features to lessen the possiblity of flooding or drainage into the well?

Each of the seven drillers replying to this question stated they try to locate the well on high ground.

(3) What method of well construction do you recommend for Mendocino County?

Eleven drillers recommended cable tool; two recommended rotary; one recommended cable tool, rotary, or dug; and one stated the method depends upon the location.

(4) What material do you recommend for casing to last at least 20 years?

Five drillers recommended "hard red" steel pipe only. Three recommended hard red pipe as well as other types including standard

American Petroleum Institute (API) pipe, wrought iron, steel plate, Kai-well, plastic, and concrete (for dug wells).

(5) What minimum weight casing would you recommend for wells in alluvial material of Mendocino County for the following diameter and depth ranges?

Depth	0 - 400 feet
Diameter	4 - 30 inches

Four drillers recommended 12 gage minimum and three recommended 10 gage minimum. Ten other drillers made recommendations ranging from 14 gage for depths of 0 to 100 feet, to 3/8 inch for depths of 0 to 400 feet and casing diameters of 18 to 30 inches.

(6) Is any distinction generally made between domestic wells and wells intended for other purposes with respect to casing weights and materials?

Four drillers reported they made no distinction. Ten drillers reported they use heavier casing material for irrigation wells or other wells of high volume, generally because of the larger diameters and greater depths.

(7) Do you use single or double casing in Mendocino County?

Six drillers reported they use only single casing in Mendocino County. One stated he uses single most often but some double casing in deep wells.

(8) Do you recommend the use of used casing?

Five drillers stated no. A sixth recommended against use of used casing because it may have been used previously for gasoline or other uses which would be detrimental in water wells. One driller recommended the use of used casing provided it was in good condition.

(9) Under what conditions do you recommend that casing extend the entire depth of the well?

Nine drillers recommended casing the entire depth under all conditions, four recommended only when caving formations are encountered, and one recommended casing the entire depth to hold back fine clays.

(10) When do you seat casing in cement at the bottom of the hole?

Four stated they never have and three stated they do when necessary to seal off quicksand or heaving gravel. One stated he did not seat casing in cement but has plugged the bottom of casing to seal off sand.

(11) What type of casing joint do you recommend?

Thirteen drillers recommended using butt welded joints. One driller preferred to use threaded collars, butt welded joints, or California stovepipe method depending on conditions. One driller preferred butt welded joints but recommended a threaded collar on light casing, and one preferred collar joints with a fillet weld.

(12) Do you think watertight joints are always necessary? If not, what do you consider the exceptions to be?

One driller stated watertight joints are not necessary in water-bearing zones, one recommended that watertight joints should be to the perforations in the casing, and two drillers recommended watertight joints to 30 feet below ground surface to provide sanitary protection. One driller recommended watertight joints to 50 feet below ground surface. Ten drillers recommended watertight joints the entire length of the casing.

(13) Is pre-perforated casing used, or is casing generally perforated in place?

Five drillers use pre-perforated casing where possible, five drillers prefer to perforate in-place, and five drillers use either method depending on conditions.

(14) Are well screens used in Mendocino County?

Eight drillers stated none have been used in Mendocino County to their knowledge. Four drillers stated that they have used well screens in the county.

(15) What proportions do you use for cement grout?

Proportions (cement:sand)	Number of drillers
Grout not used	2
1 : 2	3
1 : 3	2
1 : 3 or 4 (water as required)	1
1 : 3.5 or 4	1
1 : 4 or 5	1
1 : 5 (thick paste)	1
1 sack cement to 6.5 gallons water, plus calcium chloride	1

(16) What methods and material would you recommend for sealing off undesirable water strata in wells?

(a) Nongravel-packed wells

Method	Number of drillers
Cement, grout, or concrete	7
Cement, or conductor pipe	1
Liner pipe and cement	1
Liner pipe and cement, cement in annular space, or watertight casing	1
Clay and cement	1
Watertight casing	1
Watertight casing and cement block at surface	1

(b) Gravel-packed wells

Method	Number of drillers
Cement or grout	4
Cement under pressure	1
Cement, clay, and cement cap	1
Liner pipe and cement, cement in annular space, or watertight casing	1

(17) What is the general practice in Mendocino County with respect to provision of sanitary seals?

One driller reported he felt it is the well owner's responsibility and therefore he follows the instructions of the owner. Two drillers reported they follow recommendations of the Mendocino County Health Department. One driller stated that he fills the top two or three feet with concrete. One driller reported that he provides no sanitary seal. One driller reported that he cases off the top 50 feet of the well if within 50 feet of a sewage disposal system.

(18) What minimum distance do you recommend that unperforated watertight casing extend below ground surface to provide a satisfactory sanitary seal?

(a) In nongravel-packed wells?

Six drillers recommended that blank watertight casing extend to normal ground water level. Three drillers recommended 30 feet minimum, two drillers recommended watertight casing to a minimum of 50 feet, one driller recommended a minimum of 25 feet, and one recommended a minimum of 20 feet.

(b) In gravel-packed wells?

Four drillers stated that blank watertight casing should extend to normal ground water level, and two drillers recommended a minimum of 30 feet.

(19) Should watertight casing extend to an impervious stratum, if feasible?

Fourteen drillers stated this was desirable, and one driller thought it was not necessary.

(20) What techniques do you recommend to seal off surface waters?

Recommendation	Number of drillers
Watertight casing	2
Watertight casing or casing with cement outside	1
Watertight casing with cement outside	1
Watertight casing or concrete seal on top	1
Watertight casing with light clay outside or concrete seal on top	1
Concrete seal on top	2
Conductor pipe with concrete seal or rotary mud on top	1
Grout from bottom up	2
Grout to impervious strata or perforations	3
Cement top 3 feet	1
Cement top 20 feet	1

(21) How do you seal off the annular space outside the casing in a gravel-packed well?

Practice	Number of drillers
30 - 35 feet of rotary mud	1
Cement grout	6
Cement grout or natural material	1
Cement grout under pressure	1
Do not seal	1

(22) What minimum distance do you recommend that casing extend above ground level or pump platform?

Recommendation	Number of drillers
Top of pump platform	1
6 to 10 inches	1
8 inches	2
10 inches	1
12 inches	8
14 inches	1
16 inches	1
18 inches	1

(23) What type of pump platform do you recommend?

Six drillers recommended concrete or cement platforms, and two recommended concrete or wood.

(24) What is your recommendation regarding installation of (a) well vents and (b) sounding tubes?

(a) Two drillers recommended vents on all wells, two recommended vents when gas is evident, one recommended a vent only in certain instances, and three stated that vents are not necessary.

(b) One driller recommended a capped, inclined pipe one or one and one-half inches in diameter for chlorination and measurement, one recommended a sealed one and one-quarter or two inch inclined pipe, and one recommended a sounding tube on a rotary well but not on a cable tool well.

(25) What type of pump seal do you recommend?

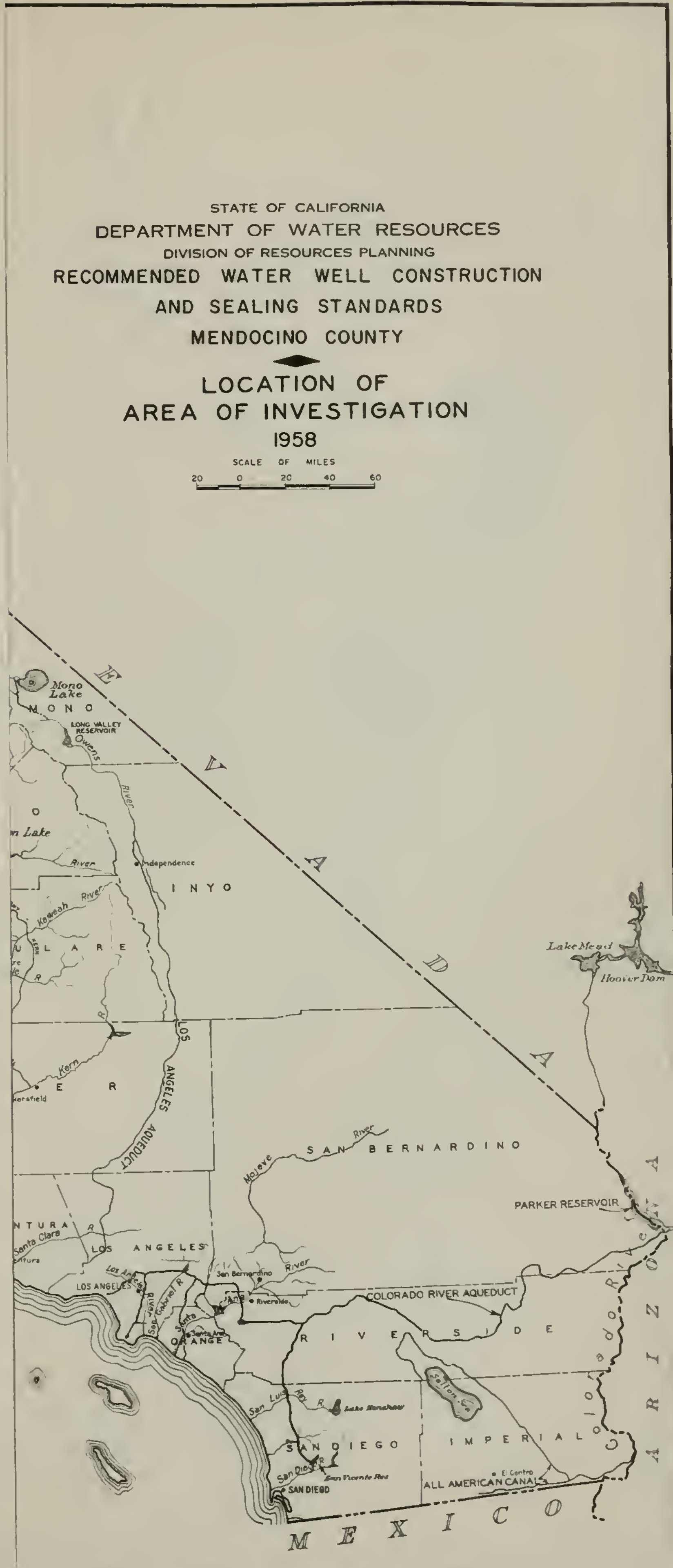
Type	Number of drillers
Welded	1
Rubber and metal clamps	1
Pump on casing	1
A seal that leaves no large openings	1
None	6

(26) When do you recommend the use of well pits?

Five of the seven drillers replying to this question use of well pits. Two drillers recommended the use of well pits to protect the pump installation from frost.

(27) What methods do you recommend for disinfecting wells?

Twelve drillers reported they use various compounds containing free chlorine. The usual method is to pour a mixture of an unknown amount of chlorine into the well, surge the well and let stand for a period of time ranging from 10 minutes to 2 hours before pumping the well clear. Three drillers reported they never chlorinate, and one driller reported he uses variations of the above methods only at the request of the well owner.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LOCATION OF
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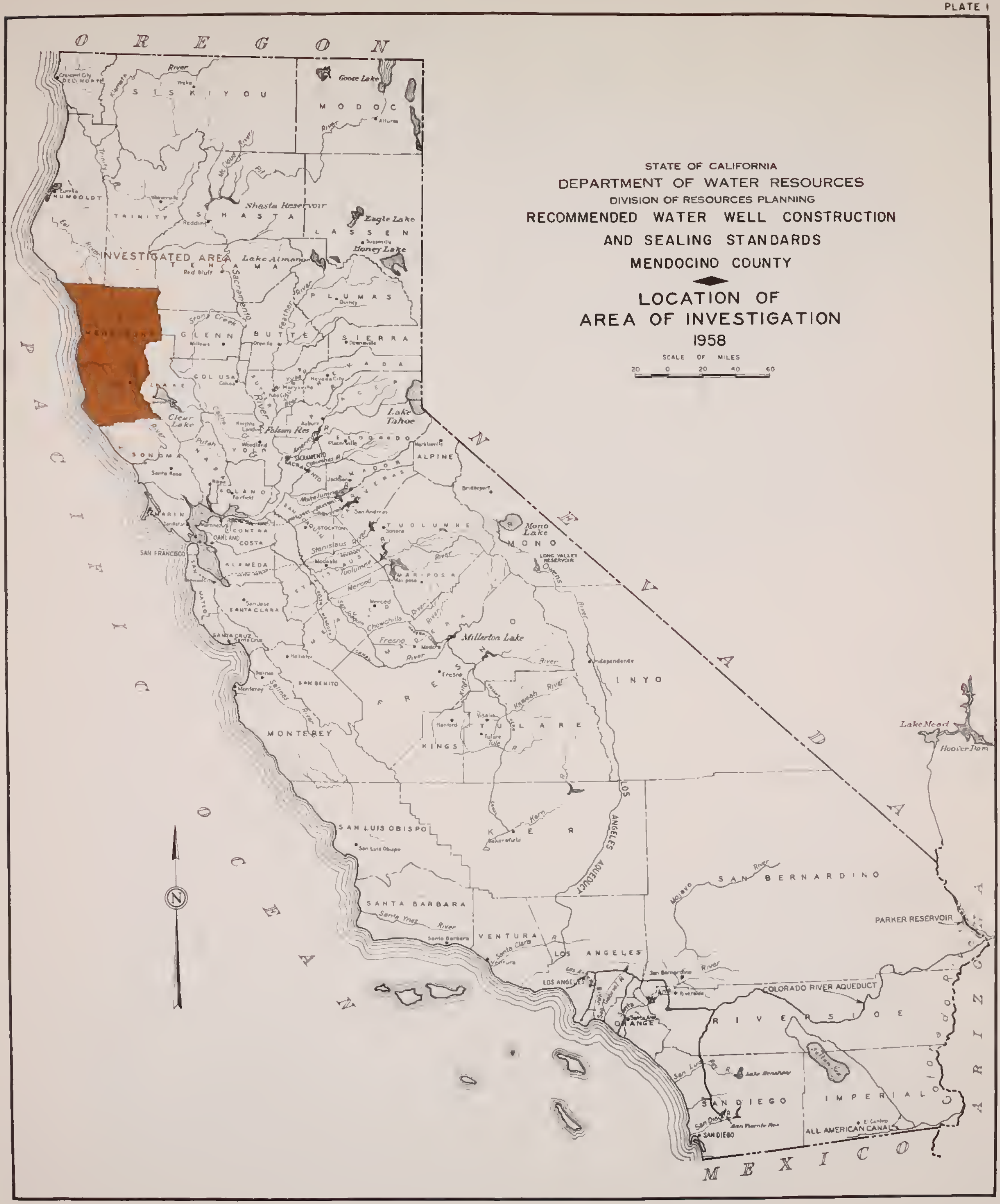
1958
SCALE OF MILES
20 0 20 40 60
Mono Lake
MONO
LONG VALLEY RESERVOIR
Owens River
Independence
INYO
Kaweah River
Kern
LOS ANGELES AQUEDUCT
SAN BERNARDINO
Mojave River
Lake Mead
Hoover Dam
PARKER RESERVOIR
LOS ANGELES
Santa Clara
San Bernardino
Riverside
COLORADO RIVER AQUEDUCT
ORANGE
RIVERSIDE
San Luis Rey R
SAN DIEGO
San Vicente Res
IMPERIAL
El Centro
ALL AMERICAN CANAL
Colorado River
MEXICO
ARIZONA
NEVADA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1958
SCALE OF MILES
20 0 20 40 60
INVESTIGATED AREA
OREGON
NEVADA
ARIZONA
MEXICO
PACIFIC OCEAN
SISKIYOU
MODOC
HUMBOLDT
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
GLENN
BUTTE
SIERRA
COLUSA
SONOMA
ALPINE
MONO
INYO
TULARE
KINGS
MONTEREY
SAN BENITO
SAN LUIS OBISPO
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
ORANGE
SAN DIEGO
IMPERIAL
Shasta Reservoir
Eagle Lake
Goose Lake
Honey Lake
Lake Almanor
Lake Tahoe
Clear Lake
Folsom Res
Mono Lake
Millerton Lake
Lake Mead
Hoover Dam
PARKER RESERVOIR
COLORADO RIVER AQUEDUCT
ALL AMERICAN CANAL
LOS ANGELES AQUEDUCT
SAN FRANCISCO
SACRAMENTO
SAN DIEGO
LOS ANGELES

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SCALE OF MILES

0 2 4 6 8 10

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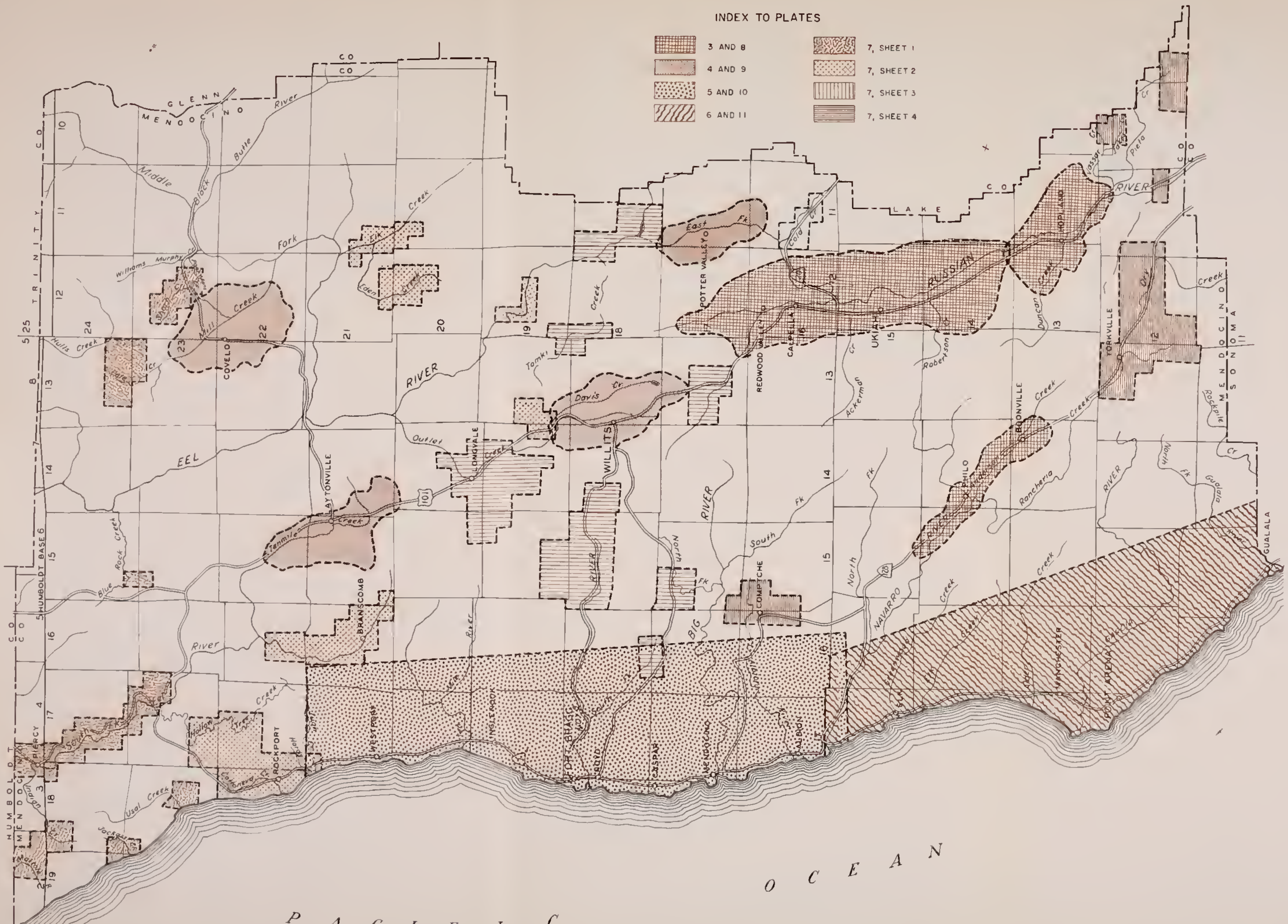

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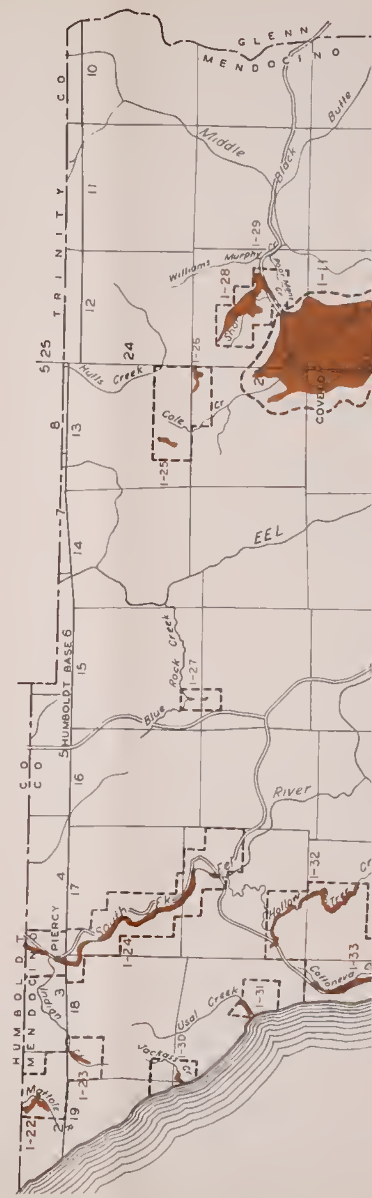

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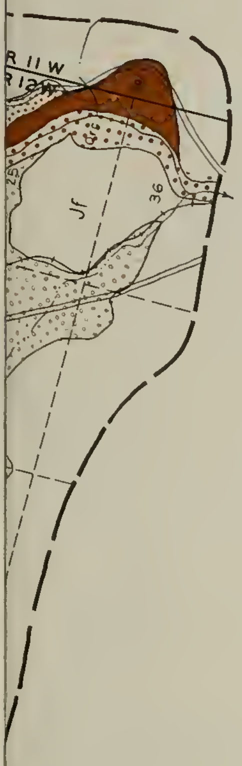


LEGEND

QUATERNARY

RECENT

Qrc — RIVER CHANNEL DEPOSITS
UNCONSOLIDATED GRAVELS WITH SAND, SILT AND CLAY

Qal — ALLUVIUM
UNCONSOLIDATED SILTS CLAYS GRAVELS AND SANDS TEXTURE COARSER NEAR STREAMS

Qoal — OLDER ALLUVIUM
UNCONSOLIDATED GRAVELLY AND SANDY SILTS AND CLAYS

PLEISTOCENE

Qt — TERRACE DEPOSITS (UNDIFFERENTIATED)

Qty — YOUNGER TERRACE DEPOSITS
UNCONSOLIDATED GRAVELLY AND SANDY SILTS COARSER AT BASE.

Qto — OLDER TERRACE DEPOSITS
UNCONSOLIDATED GRAVELLY AND SANDY SILTS WITH INTERBEDDED CLAYS, SANDS AND GRAVELS.

PLIOCENE · TERTIARY

TQ — PLIOCENE - PLEISTOCENE DEPOSITS (UNDIFFERENTIATED)
SEMI-CONSOLIDATED BLUE CLAYS SILTS. SANDY AND GRAVELLY SILTS AND LENSES OF SANDS AND GRAVELS BEDS GENTLY TO STEEPLY TILTED

PRE-CRETACEOUS

Jf — FRANCISCAN KNOXVILLE GROUP (UNDIFFERENTIATED)
PREPONDERANTLY CONSOLIDATED GRAY WACKES AND SHALES WITH SERPENTINE AND META - VOLCANICS MAY INCLUDE SOME CRETACEOUS SEDIMENTS

(CONTACT DASHED WHERE APPROXIMATELY LOCATED)

30 — ATTITUDE OF BED

15 — PREVAILING DIP OF BED

1-573 — GROUND WATER BASIN NUMBER

NUMERICAL DESIGNATION OF GROUND WATER BASINS

1-15 UKIAH VALLEY	1-19 ANDERSON VALLEY
1-16 SANEL VALLEY	1-93 Mc DOWELL VALLEY
1-94 Mc NAB CREEK VALLEY	

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING

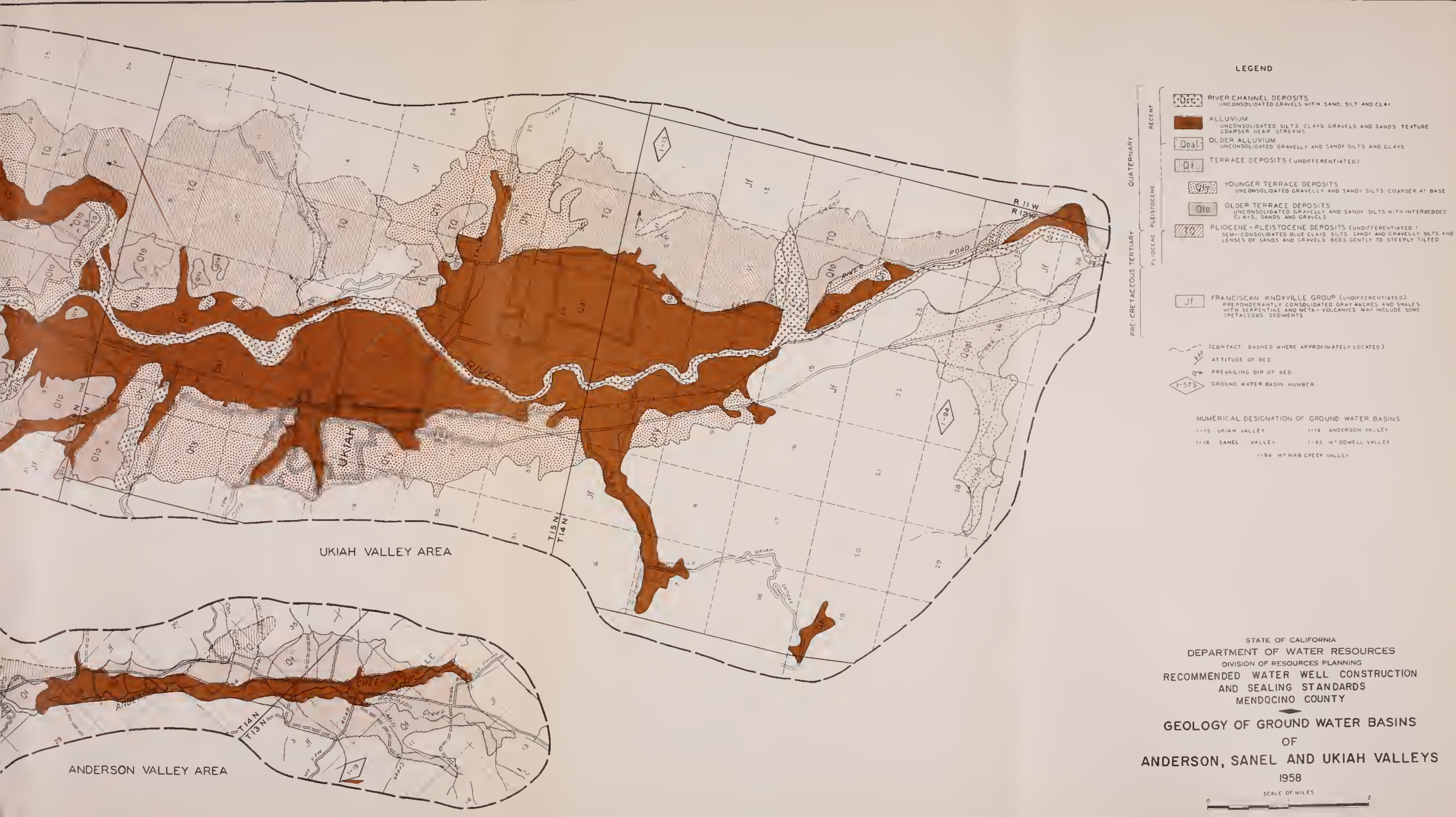
RECOMMENDED WATER WELL CONSTRUCTION AND SEALING STANDARDS
MENDOCINO COUNTY

GEOLOGY OF GROUND WATER BASINS OF ANDERSON, SANEL AND UKIAH VALLEYS

1958

SCALE OF MILES
0 1 2

SANEL VALLEY AREA
HOPLAND
ANDERSON
NAVARRO
PHILO
T14N
T13N
R11W
R12W
T13N
T12N
T17N
T16N
T15N
T14N
R14W
R15W
Qal
Qoal
TQ
Qto
Jf
Qt



STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
RECOMMENDED WATER WELL CONSTRUCTION AND SEALING STANDARDS
MENDOCINO COUNTY

GEOLOGY OF GROUND WATER BASINS OF ANDERSON, SANEL AND UKIAH VALLEYS

1958

AREA

LEGEND

QUATERNARY	RECENT	Qrc	RIVER CHANNEL DEPOSITS PREPONDERANTLY UNCONSOLIDATED GRAVELS WITH SAND, SILT AND CLAY.
		Qal	ALLUVIUM UNCONSOLIDATED SILTS, CLAYS, GRAVELS AND SANDS.
	PLEISTOCENE	Qt	TERRACE DEPOSITS UNCONSOLIDATED GRAVELLY AND SANDY SILTS AND CLAYS.
TERTIARY	PLIOCENE	TQ	PLIOCENE - PLEISTOCENE DEPOSITS (UNDIFFERENTIATED) SEMI-CONSOLIDATED BLUE CLAYS, SILTS, SANDY AND GRAVELLY SILTS WITH INTERBEDDED SANDS AND GRAVELS. BEDS GENTLY TO STEEPLY TILTED.
PRE-CRETACEOUS		Jf	FRANCISCAN- KNOXVILLE GROUP (UNDIFFERENTIATED) PREPONDERANTLY CONSOLIDATED GRAYWACKES AND SHALES WITH SERPENTINE AND META-VOLCANICS. MAY INCLUDE SOME CRETACEOUS AND TERTIARY ROCKS.

CONTACT (DASHED WHERE APPROXIMATELY LOCATED)

30 ATTITUDE OF BEDS

1-57.3 GROUND WATER BASIN NUMBER

NUMERICAL DESIGNATION OF GROUND WATER BASINS

1-11 ROUND VALLEY	1-13 LITTLE LAKE VALLEY
1-12 LAYTONVILLE VALLEY	1-14 POTTER VALLEY

STATE OF CALIFORNIA
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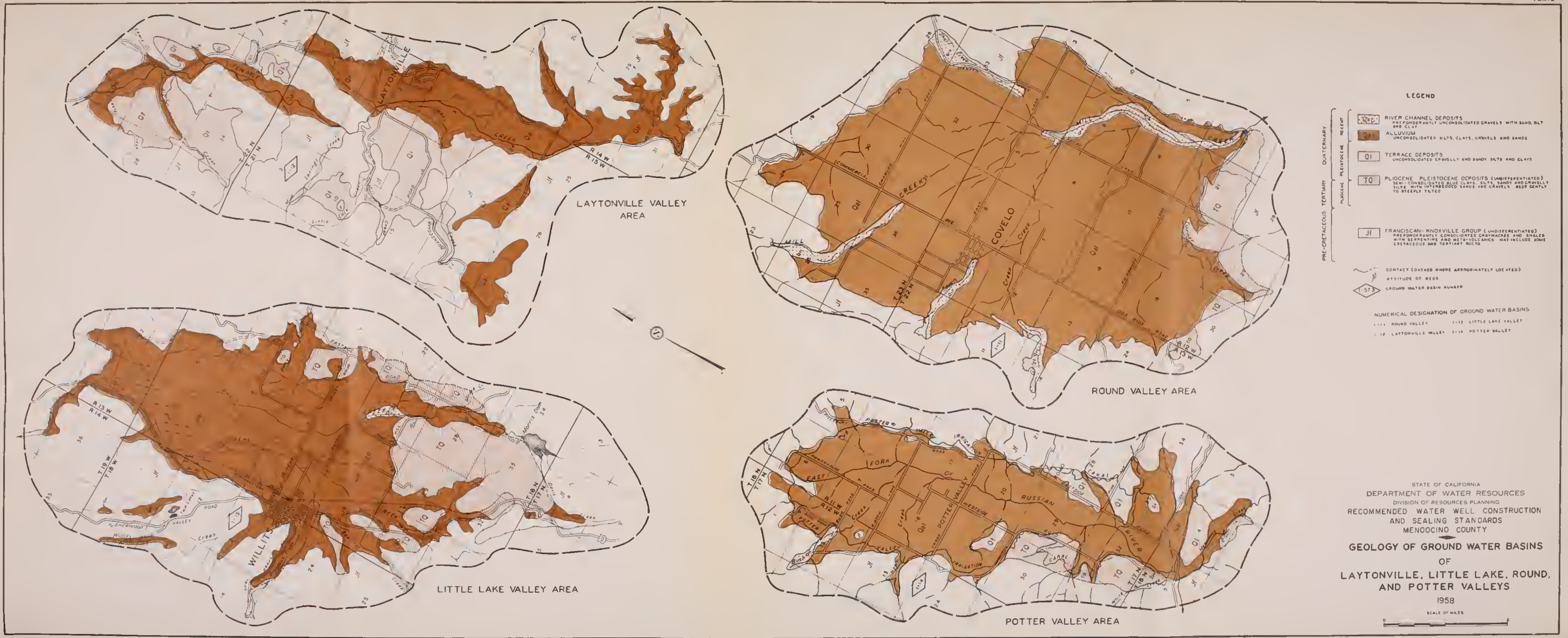
RECOMMENDED WATER WELL CONSTRUCTION
AND SEALING STANDARDS
MENDOCINO COUNTY

GEOLOGY OF GROUND WATER BASINS OF LAYTONVILLE, LITTLE LAKE, ROUND, AND POTTER VALLEYS

1958

SCALE OF MILES

0 1 2


LAYTONVILLE VALLEY AREA
LITTLE LAKE VALLEY AREA
ROUND VALLEY AREA
POTTER VALLEY AREA
LAYTONVILLE
COVELO
WILLITS
LEGEND
QUATERNARY
TERTIARY
PRE-CRETACEOUS
RECENT
PLEISTOCENE
PLIOCENE
Qrc RIVER CHANNEL DEPOSITS
PREPONDERANTLY UNCONSOLIDATED GRAVELS WITH SAND, SILT AND CLAY
Qal ALLUVIUM
UNCONSOLIDATED SILTS, CLAYS, GRAVELS AND SANDS
Qt TERRACE DEPOSITS
UNCONSOLIDATED GRAVELLY AND SANDY SILTS AND CLAYS
TQ PLIOCENE PLEISTOCENE DEPOSITS (UNDIFFERENTIATED)
SEMI-CONSOLIDATED BLUE CLAYS, SILTS, SANDY AND GRAVELLY SILTS WITH INTERBEDDED SANDS AND GRAVELS. BEDS GENTLY TO STEEPLY TILTED
Jf FRANCISCAN-KNOXVILLE GROUP (UNDIFFERENTIATED)
PREPONDERANTLY CONSOLIDATED GRAYWACKE AND SHALES WITH SERPENTINE AND META-VOLCANICS. MAY INCLUDE SOME CRETACEOUS AND TERTIARY ROCKS
CONTACT (DASHED WHERE APPROXIMATELY LOCATED)
ATTITUDE OF BEDS
1-57.3 GROUND WATER BASIN NUMBER
NUMERICAL DESIGNATION OF GROUND WATER BASINS
1-11 ROUND VALLEY
1-12 LAYTONVILLE VALLEY
1-13 LITTLE LAKE VALLEY
1-14 POTTER VALLEY
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
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MENDOCINO COUNTY
GEOLOGY OF GROUND WATER BASINS OF LAYTONVILLE, LITTLE LAKE, ROUND, AND POTTER VALLEYS
1958
SCALE OF MILES
0
1
2

LEGEND

QUATERNARY — RECENT

Qd — SAND DUNES

Qal — ALLUVIUM
UNCONSOLIDATED SILTS AND GRAVELS

QUATERNARY — PLEISTOCENE

Qt_2, Qt_1 — MARINE TERRACE DEPOSITS
UNCONSOLIDATED AND POORLY CONSOLIDATED SANDS, GRAVELS, CLAYS AND SANDY CLAYS. UP TO FIVE TERRACE LEVELS; REDUCED TO SCATTERED REMNANTS BY EROSION

JURASSIC

Jf — FRANCISCAN - KNOXVILLE GROUP (UNDIFFERENTIATED)
PREPONDERANTLY CONSOLIDATED GRAYWACKES WITH SHALES, SERPENTINE AND META VOLCANICS

CONTACT (DASHED WHERE APPROXIMATELY LOCATED)

1-57.3 — GROUND WATER BASIN NUMBER.

NUMERICAL DESIGNATION OF GROUND WATER BASINS

1-21	FORT BRAGG TERRACE	1-70	PUDDING CREEK VALLEY
1-35	JUAN CREEK VALLEY	1-71	MILL CREEK VALLEY
1-63	HOWARD CREEK VALLEY	1-72	NOYO VALLEY
1-64	DE HAVEN CREEK VALLEY	1-73	HARE CREEK VALLEY
1-65	WAGES CREEK VALLEY	1-74	CASPER CREEK VALLEY
1-66	ABALOBADIAH CREEK VALLEY	1-75	RUSSIAN GULCH VALLEY
1-67	SEASIDE CREEK VALLEY	1-76	BIG RIVER VALLEY
1-68	TEN MILE RIVER VALLEY	1-77	LITTLE RIVER VALLEY
1-69	LITTLE VALLEY	1-78	ALBION RIVER VALLEY
		1-79	SALMON CREEK VALLEY

STATE OF CALIFORNIA
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MENDOCINO COUNTY

GEOLOGY OF GROUND WATER BASINS OF FORT BRAGG TERRACE AND CONTIGUOUS AREAS

1958

SCALE OF MILES
0 1 2

LEGEND

QUATERNARY — RECENT

Qd	SAND DUNES
Qal	ALLUVIUM UNCONSOLIDATED SILTS AND GRAVELS

QUATERNARY — PLEISTOCENE

Qt₂ / Qt₁	MARINE TERRACE DEPOSITS UNCONSOLIDATED AND POORLY CONSOLIDATED SANDS, GRAVELS, CLAYS AND SANDY CLAYS. UP TO FIVE TERRACE LEVELS; REDUCED TO SCATTERED REMNANTS BY EROSION

JURASSIC

Jf	FRANCISCAN - KNOXVILLE GROUP (UNDIFFERENTIATED) PREPONDERANTLY CONSOLIDATED GRAYWACKES WITH SHALES, SERPENTINE AND META VOLCANICS.

CONTACT (DASHED WHERE APPROXIMATELY LOCATED)

1-57.3 GROUND WATER BASIN NUMBER.

NUMERICAL DESIGNATION OF GROUND WATER BASINS

1-21	FORT BRAGG TERRACE	1-70	PUDDING CREEK VALLEY
1-35	JUAN CREEK VALLEY	1-71	MILL CREEK VALLEY
1-83	HOWARD CREEK VALLEY	1-72	NOYO VALLEY
1-64	DE HAVEN CREEK VALLEY	1-73	HARE CREEK VALLEY
1-65	WAGES CREEK VALLEY	1-74	CASPER CREEK VALLEY
1-66	ABALOBADIAN CREEK VALLEY	1-75	RUSSIAN GULCH VALLEY
1-67	SEASIDE CREEK VALLEY	1-76	BIG RIVER VALLEY
1-68	TEN MILE RIVER VALLEY	1-77	LITTLE RIVER VALLEY
1-69	LITTLE VALLEY	1-78	ALBION RIVER VALLEY
		1-79	SALMON CREEK VALLEY

STATE OF CALIFORNIA
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MENDOCINO COUNTY

GEOLOGY OF GROUND WATER BASINS OF FORT BRAGG TERRACE AND CONTIGUOUS AREAS

1958

SCALE OF MILES
0 1 2

T 22 N
T 21 N
T 21 N
T 20 N
T 20 N
T 19 N
T 19 N
T 18 N
R 16 W
R 17 W
R 17 W
R 18 W
WESTPORT
INGLENOOK
FORT BRAGG
NORTH
FORK
TEN
MILE
RIVER
Little
North
Fork
Smith
Creek
Campbell
Creek
I-35
I-63
I-64
I-65
I-66
I-67
I-68
I-69
I-70
I-71
I-72
I-73
P A C I F I C


LEGEND
QUATERNARY
RECENT
PLEISTOCENE
JURASSIC
Qd SAND DUNES
Qal ALLUVIUM
UNCONSOLIDATED SILTS AND GRAVELS
Qtu / Qt MARINE TERRACE DEPOSITS
UNCONSOLIDATED AND POORLY CONSOLIDATED SANDS, GRAVELS, CLAYS AND SANDY CLAYS UP TO FIVE TERRACE LEVELS, REDUCED TO SCATTERED REMNANTS BY EROSION
Jf FRANCISCAN - KNOXVILLE GROUP (UNDIFFERENTIATED)
PREDOMINANTLY CONSOLIDATED GRAYWACKES WITH SHALES, SERPENTINE AND META VOLCANICS
CONTACT (DASHED WHERE APPROXIMATELY LOCATED)
1-573 GROUND WATER BASIN NUMBER
NUMERICAL DESIGNATION OF GROUND WATER BASINS
1-21 FORT BRAGG TERRACE
1-35 JUAN CREEK VALLEY
1-63 HOWARD CREEK VALLEY
1-64 DE HAVEN CREEK VALLEY
1-65 WAGES CREEK VALLEY
1-66 ABALOBADIAN CREEK VALLEY
1-67 SEASIDE CREEK VALLEY
1-68 TEN MILE RIVER VALLEY
1-69 LITTLE VALLEY
1-70 PUDDING CREEK VALLEY
1-71 MILL CREEK VALLEY
1-72 NOYO VALLEY
1-73 HARE CREEK VALLEY
1-74 CASPER CREEK VALLEY
1-75 RUSSIAN GULCH VALLEY
1-76 BIG RIVER VALLEY
1-77 LITTLE RIVER VALLEY
1-78 ALBION RIVER VALLEY
1-79 SALMON CREEK VALLEY
STATE OF CALIFORNIA
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AND SEALING STANDARDS
MENDOCINO COUNTY
GEOLOGY OF GROUND WATER BASINS
OF
FORT BRAGG TERRACE AND CONTIGUOUS AREAS
1958
SCALE OF MILES
OCEAN
MENDOCINO
CASPAR
LITTLE RIVER
ALBION
R 18 W
R 17 W
T 18 N
T 17 N
T 16 N
T 15 N

LEGEND

QUATERNARY — RECENT

- Qd — SAND DUNES
- Qal — ALLUVIUM
  UNCONSOLIDATED SILTS, GRAVELS, CLAYS AND SANDS.

QUATERNARY — PLEISTOCENE

- Qt_2 / Qt_1 — MARINE TERRACE DEPOSITS
  UNCONSOLIDATED AND POORLY CONSOLIDATED SANDS, GRAVELS, CLAYS AND SANDY CLAYS. UP TO FIVE TERRACE LEVELS; REDUCED TO SCATTERED REMNANTS BY EROSION.

TERTIARY — EOCENE-MIOCENE

- T — POINT ARENA BEDS, GALLAWAY BEDS, AND SKOONER GULCH BASALT, (OF MIOCENE AND PRE-MIOCENE AGE, UNDIFFERENTIATED.)
  MODERATELY CONSOLIDATED FORAMINIFERAL, DIATOMACEOUS, CHERTY AND CLAY SHALES WITH MASSIVE AND LAMINATED SANDSTONES. BASALT FLOWS AND INTERCALATED TUFFACEOUS SANDSTONE UNDERLIE THE TERTIARY SEDIMENTS.

CRETACEOUS

- K — GUALALA SERIES
  CONSOLIDATED SANDSTONES, SHALES AND CONGLOMERATES

JURASSIC

- Jf — FRANCISCAN-KNOXVILLE GROUP (UNDIFFERENTIATED.)
  PREPONDERANTLY CONSOLIDATED GRAYWACKES WITH SHALES, SERPENTINE, AND META-VOLCANICS.

CONTACT (DASHED WHERE APPROXIMATELY LOCATED)

1-20 — GROUND WATER BASIN NUMBER

NUMERICAL DESIGNATION OF GROUND WATER BASINS

1-20	POINT ARENA TERRACE	1-86	GARCIA RIVER VALLEY
1-80	NAVARRO RIVER VALLEY	1-87	POINT ARENA CREEK VALLEY
1-81	GREENWOOD CREEK VALLEY	1-88	MATE CREEK VALLEY
1-82	CLIFF VALLEY	1-89	ROSS CREEK VALLEY
1-83	ALDER CREEK VALLEY	1-90	GALLOWAY CREEK VALLEY
1-84	STARAMELLA RANCH VALLEY	1-91	SCHOONER GULCH VALLEY
1-85	BRUSH CREEK VALLEY	1-92	GUALALA RIVER VALLEY

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MENDOCINO COUNTY

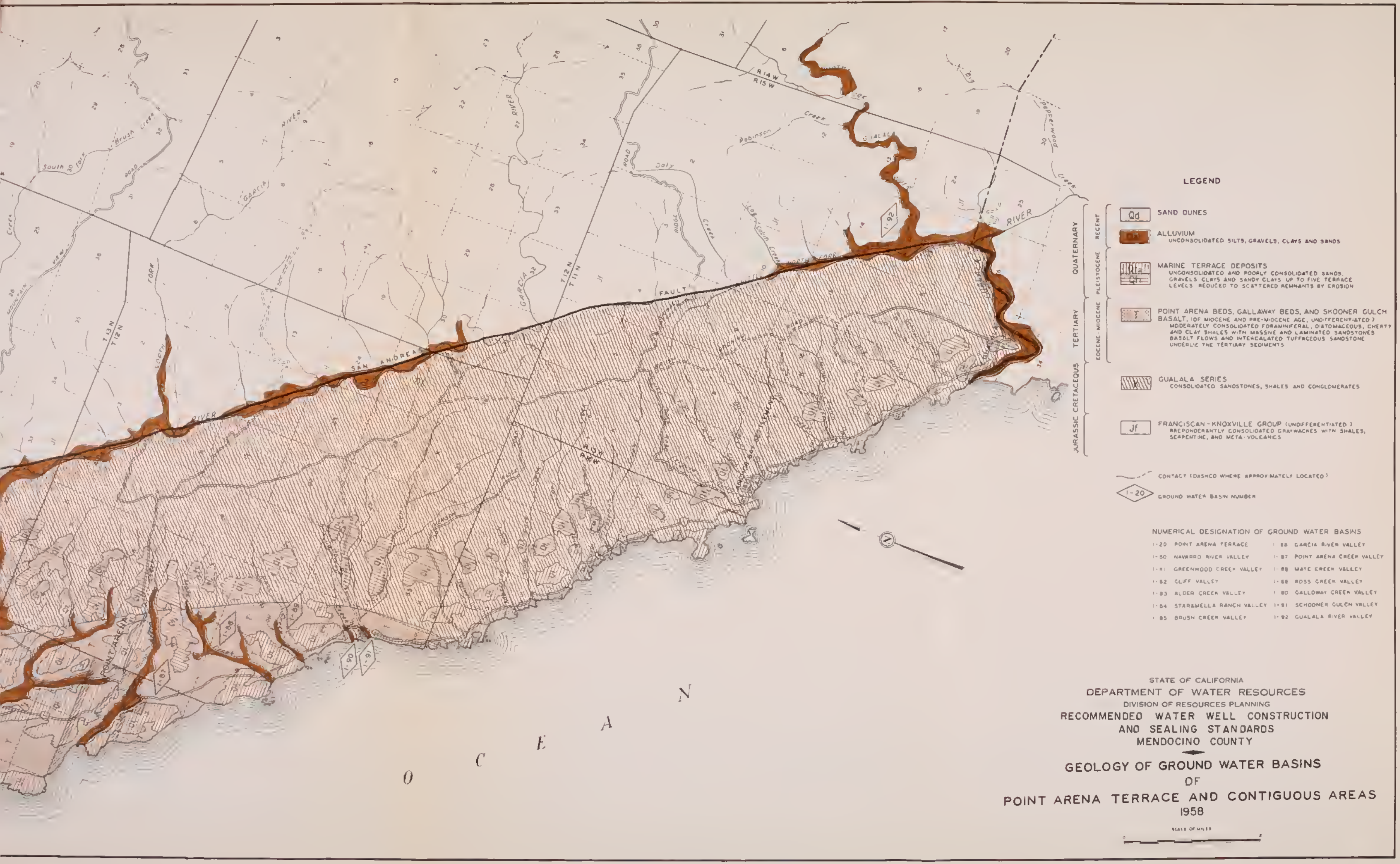
GEOLOGY OF GROUND WATER BASINS OF POINT ARENA TERRACE AND CONTIGUOUS AREAS

1958

SCALE OF MILES

0 1 2


P A C I F I C
NAVARRO
RIVER
ELK
Greenwood
Creek
Gulch
Morsh Gulch
GREENWOOD RIDGE
CLIFF RIDGE ROAD
ELK Creek
South Fork Elk Creek
Alder Creek
Bee Tree Creek
Tin Can Creek
Nye Creek
Brush Creek
Mills
Bridgeport Landing
Point Arena
R 16 W
R 17 W
R 15 W
T 16 N
T 15 N
T 14 N
T 13 N
1-80
1-81
1-82
1-83
1-84



STATE OF CALIFORNIA
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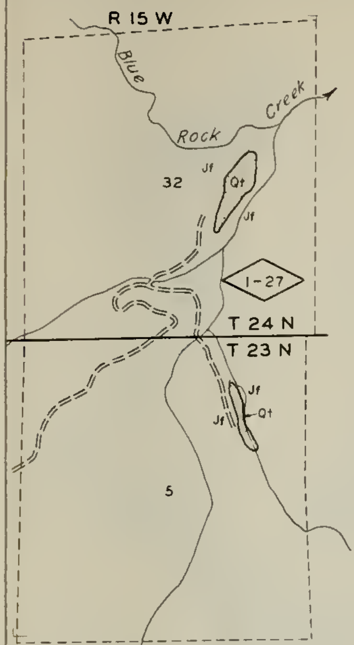
MENDOCINO COUNTY

GEOLOGY OF GROUND WATER BASINS OF POINT ARENA TERRACE AND CONTIGUOUS AREAS
1958



BLUE ROCK CREEK AREA

SCALE OF MILES

0 — 1

AREAS

LEGEND

QUATERNARY — RECENT

Qal — ALLUVIUM (INCLUDING RIVER CHANNEL DEPOSITS) UNCONSOLIDATED SILTS, GRAVELS, CLAYS AND SANDS.

QUATERNARY — PLIESTOCENE

Qt — TERRACE DEPOSITS UNCONSOLIDATED GRAVELS, SANDS, SILTS AND CLAYS

PRE-CRETACEOUS

Jf — FRANCISCAN-KNOXVILLE GROUP (UNDIFFERENTIATED.) PREPONDERANTLY CONSOLIDATED GRAYWACKES AND SHALES WITH SERPENTINE AND META-VOLCANICS MAY INCLUDE SOME CRETACEOUS SEDIMENTS.

- ALLUVIAL CONTACT
- DI LOCATION OF WATER WELL
- LOG AVAILABLE
- WELL CONSTRUCTION SURVEY
- WELL CONSTRUCTION SURVEY AND BACTERIAL ANALYSIS
- COMPLETE MINERAL ANALYSIS OF GROUND WATER
- ⊕ COMPLETE MINERAL ANALYSIS OF SURFACE WATER
- DIRECTION OF STREAM FLOW
- 1-57 3 GROUND WATER BASIN NUMBER

NUMERICAL DESIGNATION OF GROUND WATER BASINS

1-22	MATTOLE RIVER VALLEY	1-27	BLUE ROCK CREEK VALLEY
1-23	INDIAN CREEK VALLEY	1-28	WILLIAMS VALLEY
1-24	SOUTH FORK EEL RIVER	1-29	POOR MANS VALLEY
1-25	SUMMIT VALLEY	1-30	JACKASS CREEK VALLEY
1-26	HULLS VALLEY	1-31	USAL CREEK VALLEY

STATE OF CALIFORNIA

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RECOMMENDED WATER WELL CONSTRUCTION AND SEALING STANDARDS MENDOCINO COUNTY

GEOLOGY OF GROUND WATER BASINS AND LOCATION OF WELLS AND SAMPLING POINTS IN THE MINOR VALLEYS

1958

SHEET 1 OF 4 SHEETS

SCALE OF MILES (UNLESS OTHERWISE NOTED)

0 — 1 — 2

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
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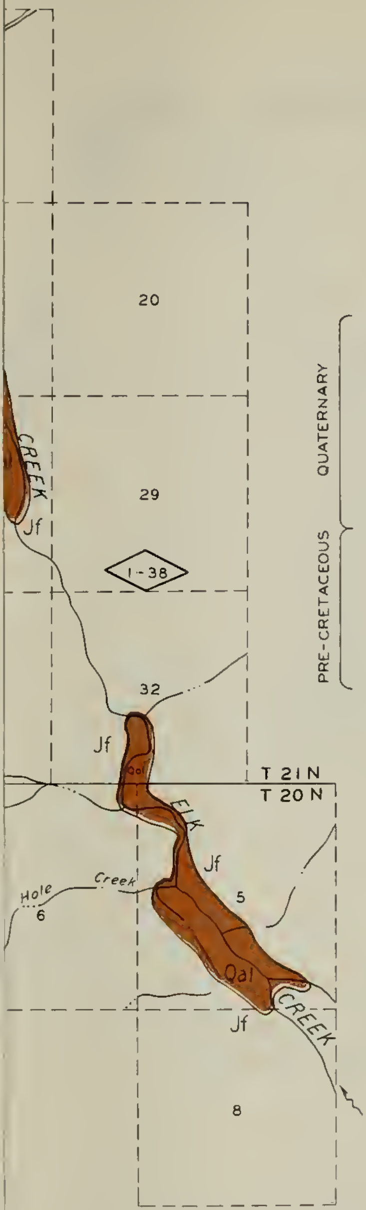
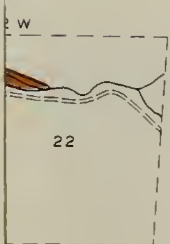
RECOMMENDED WATER WELL CONSTRUCTION AND SEALING STANDARDS
MENDOCINO COUNTY

GEOLOGY OF GROUND WATER BASINS
AND
LOCATION OF WELLS AND SAMPLING POINTS
IN
THE MINOR VALLEYS
1958
SHEET 1 OF 4 SHEETS
SCALE OF MILES
UNLESS OTHERWISE NOTED



ELK CREEK AREA



LEGEND

QUATERNARY — RECENT, PLIESTOCENE

- Qal — ALLUVIUM (INCLUDING RIVER CHANNEL DEPOSITS) UNCONSOLIDATED SILTS, GRAVELS, CLAYS AND SANDS
- Qt — TERRACE DEPOSITS UNCONSOLIDATED GRAVELS, SANDS, SILTS AND CLAYS

PRE-CRETACEOUS

- Jf — FRANCISCAN-KNOXVILLE GROUP (UNDIFFERENTIATED) PREPONDERANTLY CONSOLIDATED GRAYWACKES AND SHALES WITH SERPENTINE AND META-VOLCANICS MAY INCLUDE SOME CRETACEOUS SEDIMENTS.

- ALLUVIAL CONTACT
- DI LOCATION OF WATER WELL
- LOG AVAILABLE
- WELL CONSTRUCTION SURVEY
- WELL CONSTRUCTION SURVEY AND BACTERIAL ANALYSIS
- COMPLETE MINERAL ANALYSIS OF GROUND WATER
- COMPLETE MINERAL ANALYSIS OF SURFACE WATER
- DIRECTION OF STREAM FLOW
- 1-57 3 — GROUND WATER BASIN NUMBER

NUMERICAL DESIGNATION OF GROUND WATER BASINS

1-32	HOLLOW TREE CREEK VALLEY	1-37	EDEN VALLEY
1-33	COTTONEVA CREEK VALLEY	1-38	ELK CREEK VALLEY
1-34	HARDY CREEK VALLEY	1-39	HEARST VALLEY
1-35	JUAN CREEK VALLEY	1-40	RYAN CREEK VALLEY
1-36	BRANSCOMB VALLEY	1-41	WHEELBARROW CREEK VALLEY

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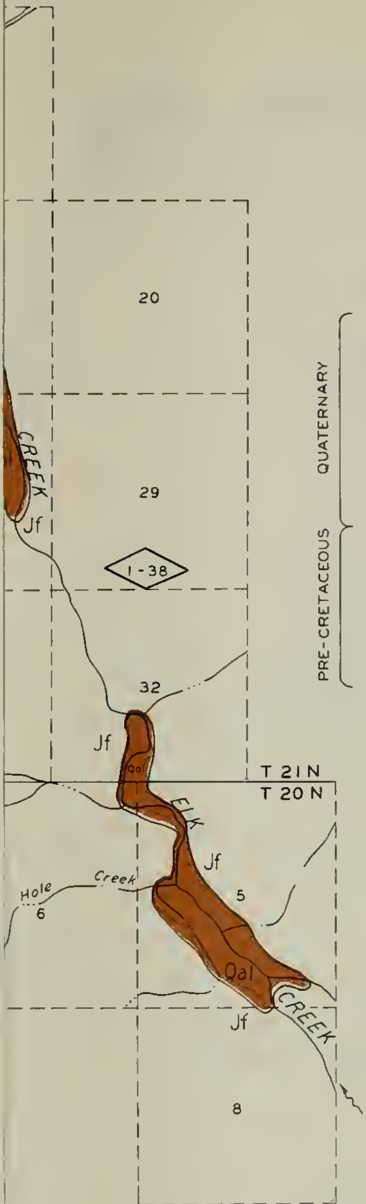
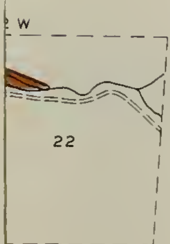
GEOLOGY OF GROUND WATER BASINS AND LOCATION OF WELLS AND SAMPLING POINTS IN THE MINOR VALLEYS

1958
SHEET 2 OF 4 SHEETS

SCALE OF MILES
0 1 2



ELK CREEK AREA



LEGEND

QUATERNARY — RECENT — PLIESTOCENE

Qal — ALLUVIUM (INCLUDING RIVER CHANNEL DEPOSITS) UNCONSOLIDATED SILTS, GRAVELS, CLAYS AND SANDS

Qt — TERRACE DEPOSITS UNCONSOLIDATED GRAVELS, SANDS, SILTS AND CLAYS

PRE-CRETACEOUS

Jf — FRANCISCAN-KNOXVILLE GROUP (UNDIFFERENTIATED) PREPONDERANTLY CONSOLIDATED GRAYWACKES AND SHALES WITH SERPENTINE AND META-VOLCANICS MAY INCLUDE SOME CRETACEOUS SEDIMENTS.

ALLUVIAL CONTACT

D1 LOCATION OF WATER WELL

LOG AVAILABLE

WELL CONSTRUCTION SURVEY

WELL CONSTRUCTION SURVEY AND BACTERIAL ANALYSIS

COMPLETE MINERAL ANALYSIS OF GROUND WATER

COMPLETE MINERAL ANALYSIS OF SURFACE WATER

DIRECTION OF STREAM FLOW

1-57.3 GROUND WATER BASIN NUMBER

NUMERICAL DESIGNATION OF GROUND WATER BASINS

1-32	HOLLOW TREE CREEK VALLEY	1-37	EDEN VALLEY
1-33	COTTONEVA CREEK VALLEY	1-38	ELK CREEK VALLEY
1-34	HARDY CREEK VALLEY	1-39	HEARST VALLEY
1-35	JUAN CREEK VALLEY	1-40	RYAN CREEK VALLEY
1-36	BRANSCOMB VALLEY	1-41	WHEELBARROW CREEK VALLEY

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GEOLOGY OF GROUND WATER BASINS AND LOCATION OF WELLS AND SAMPLING POINTS IN THE MINOR VALLEYS

1958

SHEET 2 OF 4 SHEETS

SCALE OF MILES

0 1 2

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GEOLOGY OF GROUND WATER BASINS AND LOCATION OF WELLS AND SAMPLING POINTS IN THE MINOR VALLEYS

1958

SHEET 2 OF 4 SHEETS

LEGEND

QUATERNARY — RECENT
Qal — ALLUVIUM (INCLUDING RIVER CHANNEL DEPOSITS) UNCONSOLIDATED SILTS, GRAVELS, CLAYS AND SANDS.

QUATERNARY — PLIESTOCENE
Qt — TERRACE DEPOSITS UNCONSOLIDATED GRAVELS, SANDS, SILTS AND CLAYS

PRE-CRETACEOUS
Jf — FRANCISCAN-KNOXVILLE GROUP (UNDIFFERENTIATED.) PREPONDERANTLY CONSOLIDATED GRAYWACKES AND SHALES WITH SERPENTINE AND META-VOLCANICS MAY INCLUDE SOME CRETACEOUS SEDIMENTS.

ALLUVIAL CONTACT

D1 LOCATION OF WATER WELL

LOG AVAILABLE

WELL CONSTRUCTION SURVEY

WELL CONSTRUCTION SURVEY AND BACTERIAL ANALYSIS

COMPLETE MINERAL ANALYSIS OF GROUND WATER

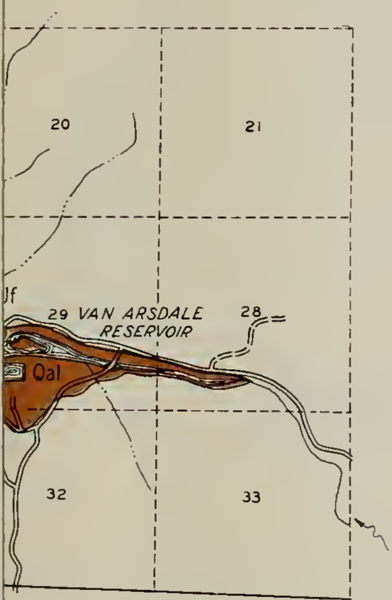
COMPLETE MINERAL ANALYSIS OF SURFACE WATER

DIRECTION OF STREAM FLOW

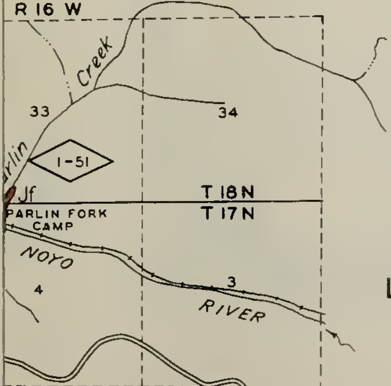
1-57.3 GROUND WATER BASIN NUMBER

NUMERICAL DESIGNATION OF GROUND WATER BASINS

1-42	SHERWOOD VALLEY	1-48	VAN ARSDALE VALLEY
1-43	CURLEY COW CREEK VALLEY	1-49	FORSYTHE CREEK VALLEY
1-44	ROWES CREEK VALLEY	1-50	NOYO RIVER VALLEY
1-45	OUTLET CREEK VALLEY	1-50.1	CAMP MARWEDEL VALLEY
1-46	SCOTT CREEK VALLEY	1-50.2	NORTH FORK NOYO RIVER VALLEY
1-47	TOMKI CREEK VALLEY	1-51	PARLIN CREEK VALLEY
		1-52	NORTH FORK BIG RIVER VALLEY



RSDALE AREA



FORK AREA

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
RECOMMENDED WATER WELL CONSTRUCTION AND SEALING STANDARDS
MENDOCINO COUNTY

GEOLOGY OF GROUND WATER BASINS AND LOCATION OF WELLS AND SAMPLING POINTS IN THE MINOR VALLEYS

1958
SHEET 3 OF 4 SHEETS
SCALE OF MILES
0 1 2

LEGEND

QUATERNARY — RECENT / PLIESTOCENE

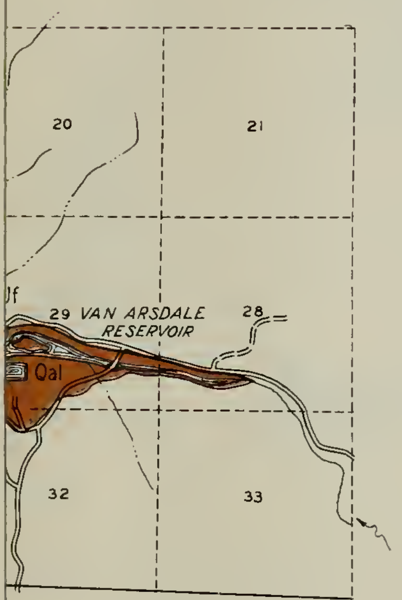
Qal — ALLUVIUM (INCLUDING RIVER CHANNEL DEPOSITS.) UNCONSOLIDATED SILTS, GRAVELS, CLAYS AND SANDS.

Qt — TERRACE DEPOSITS UNCONSOLIDATED GRAVELS, SANDS, SILTS AND CLAYS

PRE-CRETACEOUS

Jf — FRANCISCAN-KNOXVILLE GROUP (UNDIFFERENTIATED.) PREPONDERANTLY CONSOLIDATED GRAYWACKES AND SHALES WITH SERPENTINE AND META-VOLCANICS. MAY INCLUDE SOME CRETACEOUS SEDIMENTS.

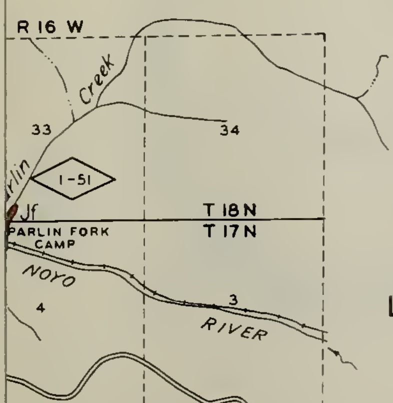
- ALLUVIAL CONTACT
- D1 LOCATION OF WATER WELL
- LOG AVAILABLE
- WELL CONSTRUCTION SURVEY
- WELL CONSTRUCTION SURVEY AND BACTERIAL ANALYSIS
- COMPLETE MINERAL ANALYSIS OF GROUND WATER
- COMPLETE MINERAL ANALYSIS OF SURFACE WATER
- DIRECTION OF STREAM FLOW
- 1-57 3 GROUND WATER BASIN NUMBER



RSDALE AREA

NUMERICAL DESIGNATION OF GROUND WATER BASINS

1-42	SHERWOOD VALLEY
1-43	CURLEY COW CREEK VALLEY
1-44	ROWES CREEK VALLEY
1-45	OUTLET CREEK VALLEY
1-46	SCOTT CREEK VALLEY
1-47	TOMKI CREEK VALLEY
1-48	VAN ARSDALE VALLEY
1-49	FORSYTHE CREEK VALLEY
1-50	NOYO RIVER VALLEY
1-50.1	CAMP MARWEDEL VALLEY
1-50.2	NORTH FORK NOYO RIVER VALLEY
1-51	PARLIN CREEK VALLEY
1-52	NORTH FORK BIG RIVER VALLEY



FORK AREA

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
RECOMMENDED WATER WELL CONSTRUCTION AND SEALING STANDARDS
MENDOCINO COUNTY

GEOLOGY OF GROUND WATER BASINS AND LOCATION OF WELLS AND SAMPLING POINTS IN THE MINOR VALLEYS

1958

SHEET 3 OF 4 SHEETS

SCALE OF MILES

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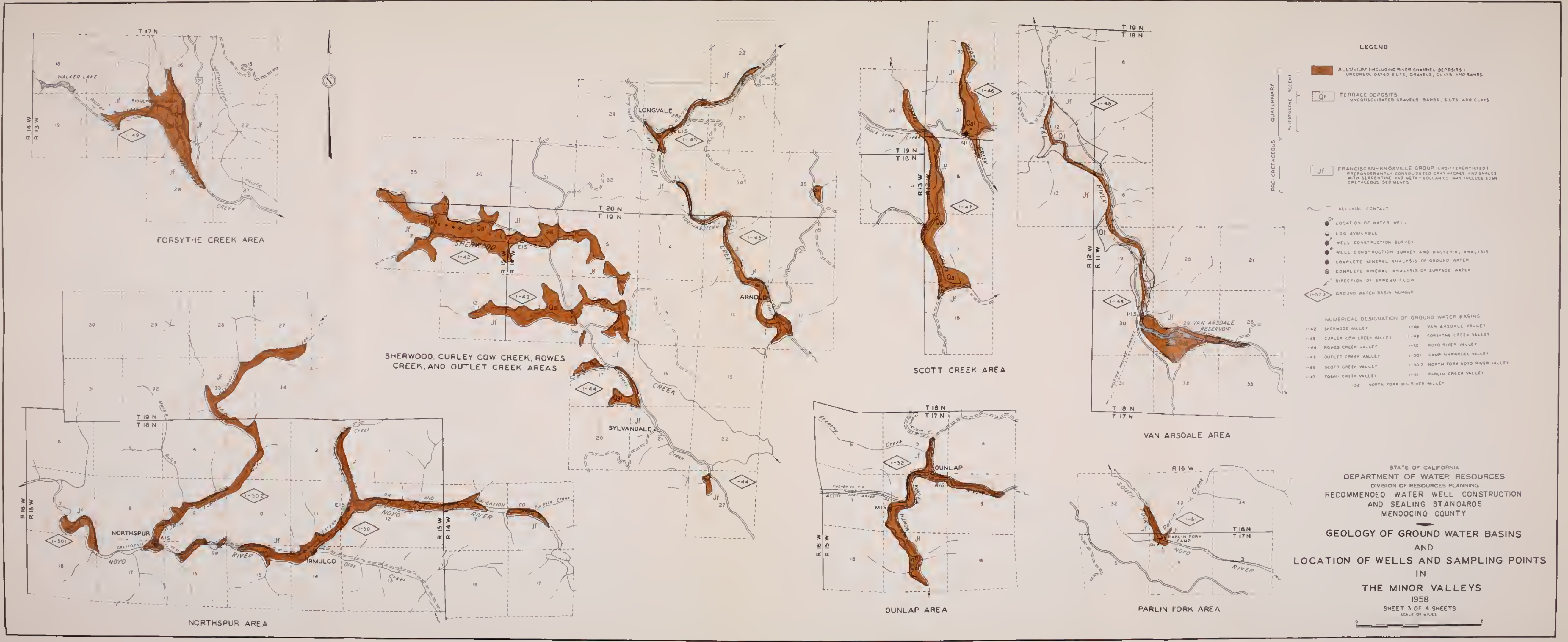
FORSYTHE CREEK AREA
SHERWOOD, CURLEY COW CREEK, ROWES CREEK, AND OUTLET CREEK AREAS
SCOTT CREEK AREA
VAN ARSDALE AREA
NORTHSPUR AREA
DUNLAP AREA
PARLIN FORK AREA
LEGEND
ALLUVIUM (INCLUDING RIVER CHANNEL DEPOSITS) UNCONSOLIDATED SILTS, GRAVELS, CLAYS AND SANDS
TERRACE DEPOSITS UNCONSOLIDATED GRAVELS, SANDS, SILTS AND CLAYS
FRANCISCAN-KNOXVILLE GROUP (UNDIFFERENTIATED) PREPONDERANTLY CONSOLIDATED GRAYWACKES AND SHALES WITH SERPENTINE AND META-VOLCANICS. MAY INCLUDE SOME CRETACEOUS SEDIMENTS
QUATERNARY
PLEISTOCENE RECENT
PRE-CRETACEOUS
ALLUVIAL CONTACT
LOCATION OF WATER WELL
LOG AVAILABLE
WELL CONSTRUCTION SURVEY
WELL CONSTRUCTION SURVEY AND BACTERIAL ANALYSIS
COMPLETE MINERAL ANALYSIS OF GROUND WATER
COMPLETE MINERAL ANALYSIS OF SURFACE WATER
DIRECTION OF STREAM FLOW
GROUND WATER BASIN NUMBER
NUMERICAL DESIGNATION OF GROUND WATER BASINS
1-42 SHERWOOD VALLEY
1-43 CURLEY COW CREEK VALLEY
1-44 ROWES CREEK VALLEY
1-45 OUTLET CREEK VALLEY
1-46 SCOTT CREEK VALLEY
1-47 TOMKI CREEK VALLEY
1-48 VAN ARSDALE VALLEY
1-49 FORSYTHE CREEK VALLEY
1-50 NOYO RIVER VALLEY
1-50.1 CAMP MARWEDEL VALLEY
1-50.2 NORTH FORK NOYO RIVER VALLEY
1-51 PARLIN CREEK VALLEY
1-52 NORTH FORK BIG RIVER VALLEY
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
RECOMMENDED WATER WELL CONSTRUCTION AND SEALING STANDARDS
MENDOCINO COUNTY
GEOLOGY OF GROUND WATER BASINS AND LOCATION OF WELLS AND SAMPLING POINTS IN THE MINOR VALLEYS
1958
SHEET 3 OF 4 SHEETS
SCALE OF MILES

LEGEND

PRE-CRETACEOUS QUATERNARY

RECENT

Qal ALLUVIUM (INCLUDING RIVER CHANNEL DEPOSITS) UNCONSOLIDATED SILTS, GRAVELS, CLAYS AND SANDS.

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ALLUVIAL CONTACT

DI LOCATION OF WATER WELL

LOG AVAILABLE

WELL CONSTRUCTION SURVEY

WELL CONSTRUCTION SURVEY AND BACTERIAL ANALYSIS

COMPLETE MINERAL ANALYSIS OF GROUND WATER

COMPLETE MINERAL ANALYSIS OF SURFACE WATER

DIRECTION OF STREAM FLOW

1-57 3 GROUND WATER BASIN NUMBER

NUMERICAL DESIGNATION OF GROUND WATER BASINS

1-53	NORTH FORK ALBION RIVER VALLEY	1-57 2	HULBERT RANCH VALLEY
1-54	COMPTCHE VALLEY	1-58	DRY CREEK VALLEY
1-55	COLD CREEK VALLEY	1-58 1	THE OAKS VALLEY
1-56	ORNBAUN VALLEY	1-59	EDWARDS CREEK VALLEY
1-57	RANCHERIA CREEK VALLEY	1-60	HIGH VALLEY
1-57.1	HIBBERD RANCH VALLEY	1-61	PIETA CREEK VALLEY

1-62 TYLER CREEK VALLEY

STATE OF CALIFORNIA
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MENDOCINO COUNTY

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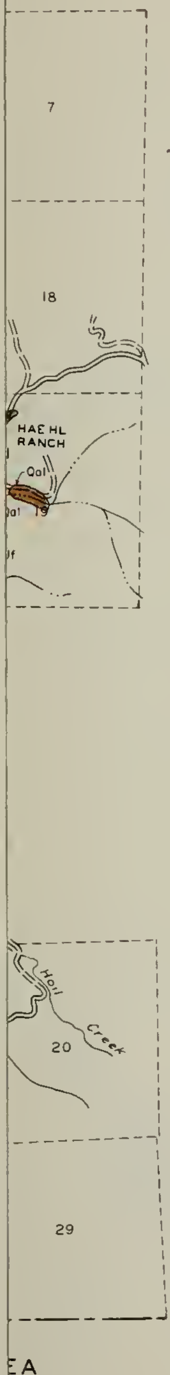
1958

SHEET 4 OF 4 SHEETS

SCALE OF MILES
(UNLESS OTHERWISE NOTED)
0 1 2



LEGEND

PRE-CRETACEOUS QUATERNARY

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D1 LOCATION OF WATER WELL

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WELL CONSTRUCTION SURVEY

WELL CONSTRUCTION SURVEY AND BACTERIAL ANALYSIS

COMPLETE MINERAL ANALYSIS OF GROUND WATER

COMPLETE MINERAL ANALYSIS OF SURFACE WATER

DIRECTION OF STREAM FLOW

1-57.3 GROUND WATER BASIN NUMBER

NUMERICAL DESIGNATION OF GROUND WATER BASINS

1-53	NORTH FORK ALBION RIVER VALLEY	1-57.2	HULBERT RANCH VALLEY
1-54	COMPTCHE VALLEY	1-58	DRY CREEK VALLEY
1-55	COLD CREEK VALLEY	1-58.1	THE OAKS VALLEY
1-56	ORNBAUN VALLEY	1-59	EDWARDS CREEK VALLEY
1-57	RANCHERIA CREEK VALLEY	1-60	HIGH VALLEY
1-57.1	HIBBERD RANCH VALLEY	1-61	PIETA CREEK VALLEY

1-62 TYLER CREEK VALLEY

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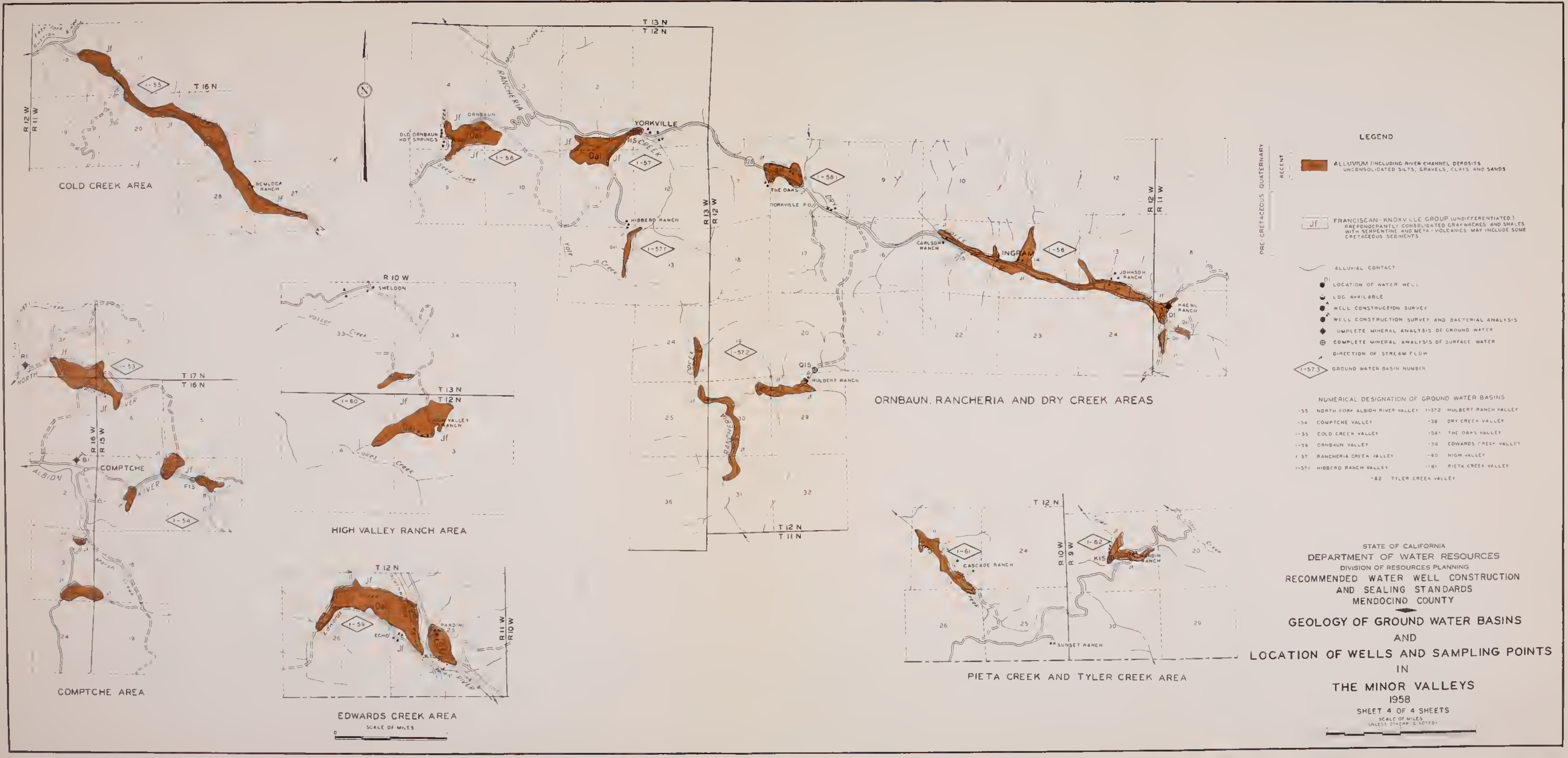
GEOLOGY OF GROUND WATER BASINS AND LOCATION OF WELLS AND SAMPLING POINTS IN THE MINOR VALLEYS

1958

SHEET 4 OF 4 SHEETS

SCALE OF MILES
(UNLESS OTHERWISE NOTED)
0 1 2


COLD CREEK AREA
COMPTCHE AREA
HIGH VALLEY RANCH AREA
EDWARDS CREEK AREA
ORNBAUN, RANCHERIA AND DRY CREEK AREAS
PIETA CREEK AND TYLER CREEK AREA
YORKVILLE
COMPTCHE
INGRAM
HIBBERD RANCH
HULBERT RANCH
CASCADE RANCH
SUNSET RANCH
SCALE OF MILES
LEGEND
QUATERNARY
RECENT
PRE-CRETACEOUS
ALLUVIUM (INCLUDING RIVER CHANNEL DEPOSITS
UNCONSOLIDATED SILTS, GRAVELS, CLAYS AND SANDS
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NUMERICAL DESIGNATION OF GROUND WATER BASINS
-55 NORTH FORK ALBION RIVER VALLEY
-54 COMPTCHE VALLEY
1-55 COLD CREEK VALLEY
1-56 ORNBAUN VALLEY
1-57 RANCHERIA CREEK VALLEY
1-57.1 HIBBERD RANCH VALLEY
1-57.2 HULBERT RANCH VALLEY
-58 DRY CREEK VALLEY
-58.1 THE OAKS VALLEY
-59 EDWARDS CREEK VALLEY
-60 HIGH VALLEY
1-61 PIETA CREEK VALLEY
-62 TYLER CREEK VALLEY
STATE OF CALIFORNIA
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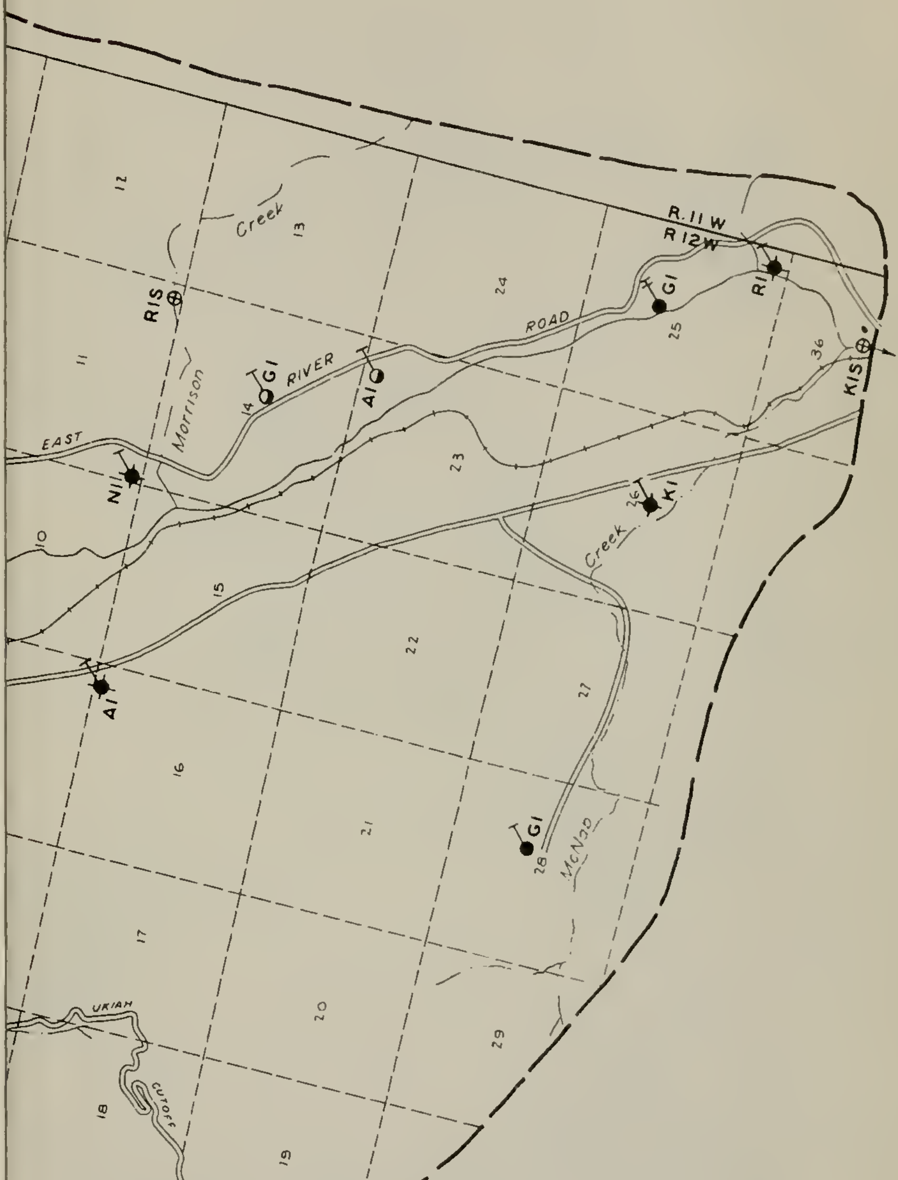
GEOLOGY OF GROUND WATER BASINS
AND
LOCATION OF WELLS AND SAMPLING POINTS
IN
THE MINOR VALLEYS
1958
SHEET 4 OF 4 SHEETS
SCALE OF MILES
(UNLESS OTHERWISE NOTED)



STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
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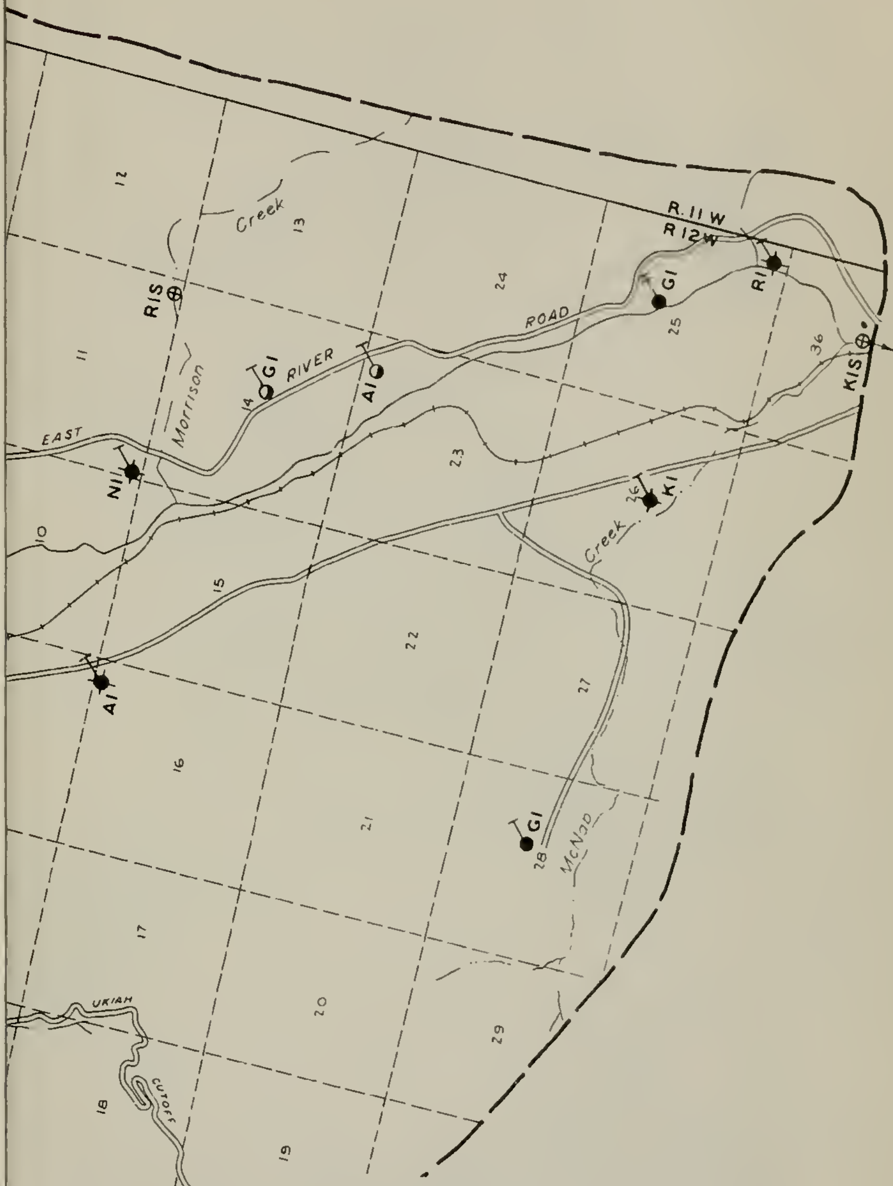
RECOMMENDED WATER WELL CONSTRUCTION
AND SEALING STANDARDS
MENDOCINO COUNTY

LOCATION OF WELLS AND SAMPLING POINTS
IN
ANDERSON, SANEL AND UKIAH VALLEYS
1958

SCALE OF MILES
0 1 2



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AND SEALING STANDARDS
MENDOCINO COUNTY

LOCATION OF WELLS AND SAMPLING POINTS
IN
ANDERSON, SANEL AND UKIAH VALLEYS
1958

SCALE OF MILES
0 1 2


LEGEND
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LOG AVAILABLE
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COMPLETE MINERAL ANALYSIS OF SURFACE WATER
DIRECTION OF STREAM FLOW
AREAS REQUIRING SPECIAL WATER WELL CONSTRUCTION AND SEALING STANDARDS
UKIAH VALLEY AREA
SANEL VALLEY AREA
ANDERSON VALLEY AREA
UKIAH
HOPLAND
RUSSIAN
RIVER
NAVARRO
PHILO
ANDERSON
R12 W
R13 W
T13 N
T12 N
T14 N
T15 N
T16 N
R11 W
STATE OF CALIFORNIA
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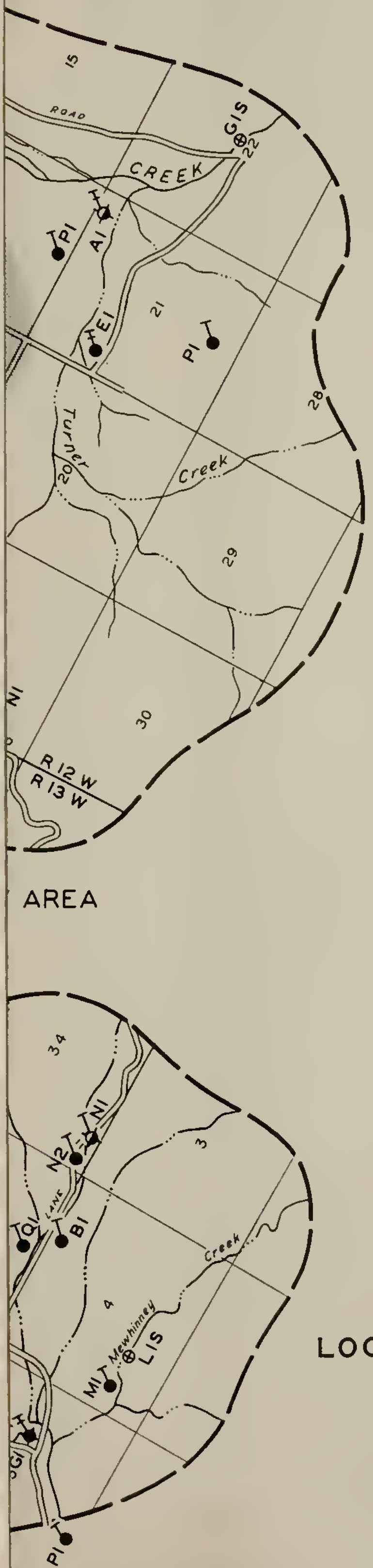
AND SEALING STANDARDS
MENDOCINO COUNTY
LOCATION OF WELLS AND SAMPLING POINTS
IN
ANDERSON SANEL AND UKIAH VALLEYS
1958



LEGEND

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MENDOCINO COUNTY

LOCATION OF WELLS AND SAMPLING POINTS IN LAYTONVILLE, LITTLE LAKE, ROUND, AND POTTER VALLEYS

1958

SCALE OF MILES

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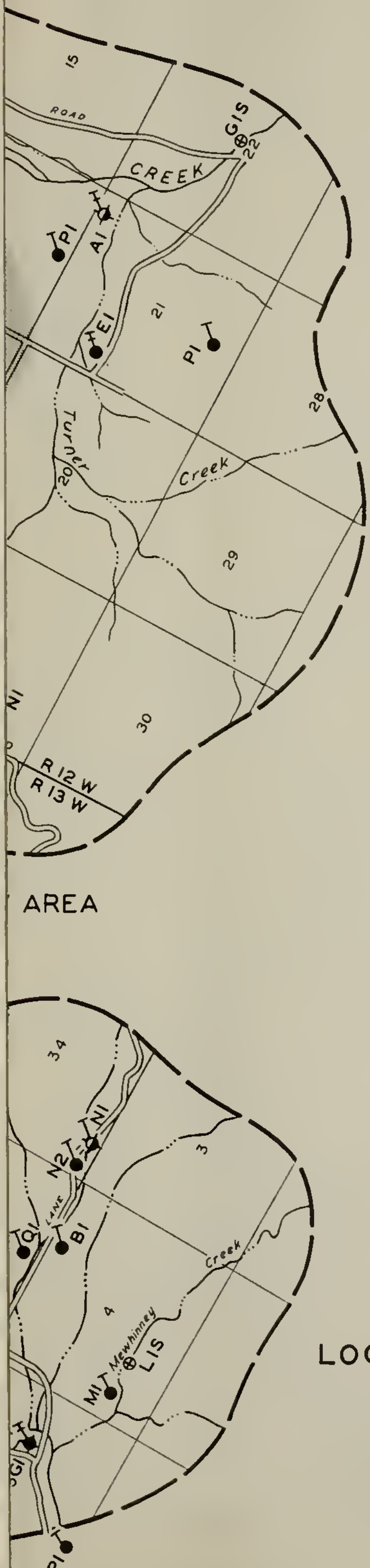

LEGEND

D1 LOCATION OF WATER WELL

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WELL CONSTRUCTION SURVEY AND BACTERIAL ANALYSIS

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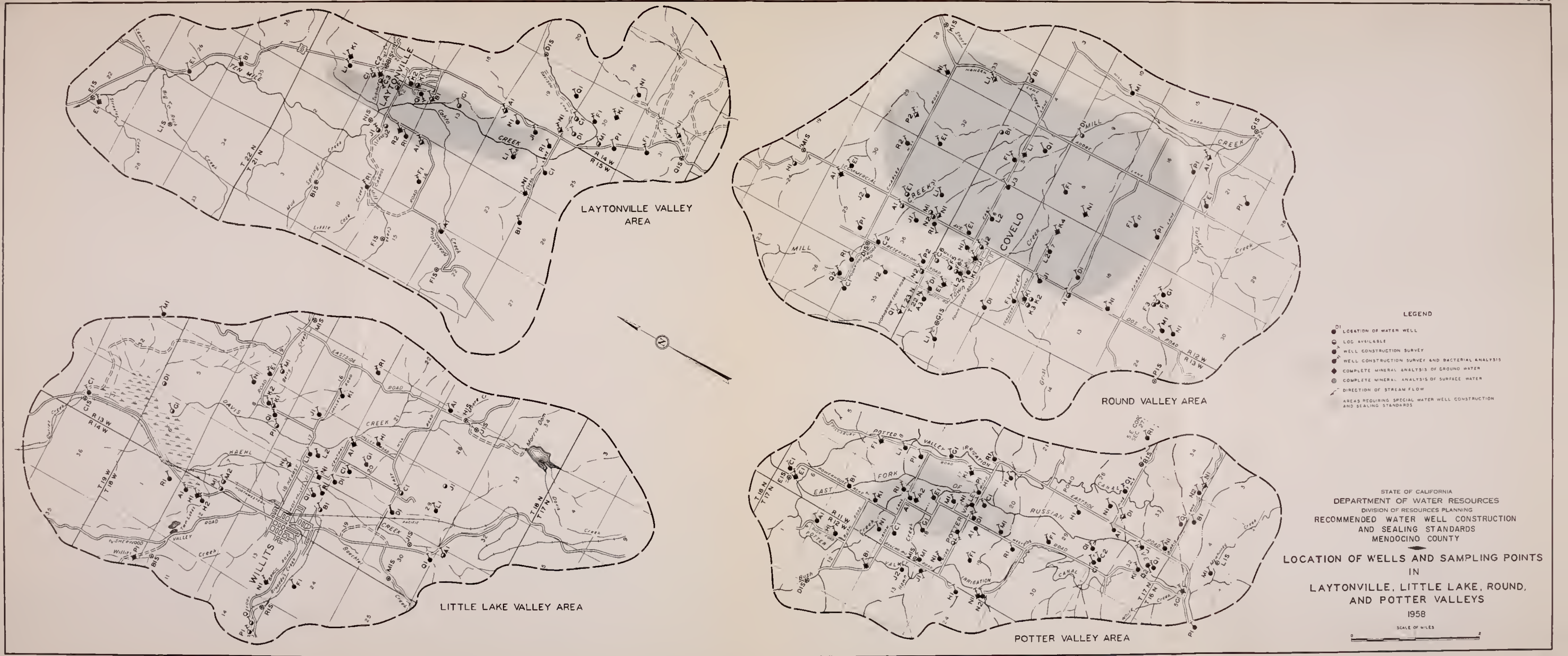
MENDOCINO COUNTY

LOCATION OF WELLS AND SAMPLING POINTS
IN
LAYTONVILLE, LITTLE LAKE, ROUND, AND POTTER VALLEYS

1958

SCALE OF MILES

0 1 2


LAYTONVILLE VALLEY AREA
LITTLE LAKE VALLEY AREA
ROUND VALLEY AREA
POTTER VALLEY AREA
LAYTONVILLE
WILLITS
COVELO
LEGEND
LOCATION OF WATER WELL
LOG AVAILABLE
WELL CONSTRUCTION SURVEY
WELL CONSTRUCTION SURVEY AND BACTERIAL ANALYSIS
COMPLETE MINERAL ANALYSIS OF GROUND WATER
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AND SEALING STANDARDS
MENDOCINO COUNTY
LOCATION OF WELLS AND SAMPLING POINTS
IN
LAYTONVILLE, LITTLE LAKE, ROUND, AND POTTER VALLEYS
1958
SCALE OF MILES
0
2

STATE OF CALIFORNIA
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AND SEALING STANDARDS
MENDOCINO COUNTY

LOCATION OF WELLS AND SAMPLING POINTS
IN
FORT BRAGG TERRACE AND CONTIGUOUS AREAS
1958

SCALE OF MILES
0 1 2

STATE OF CALIFORNIA

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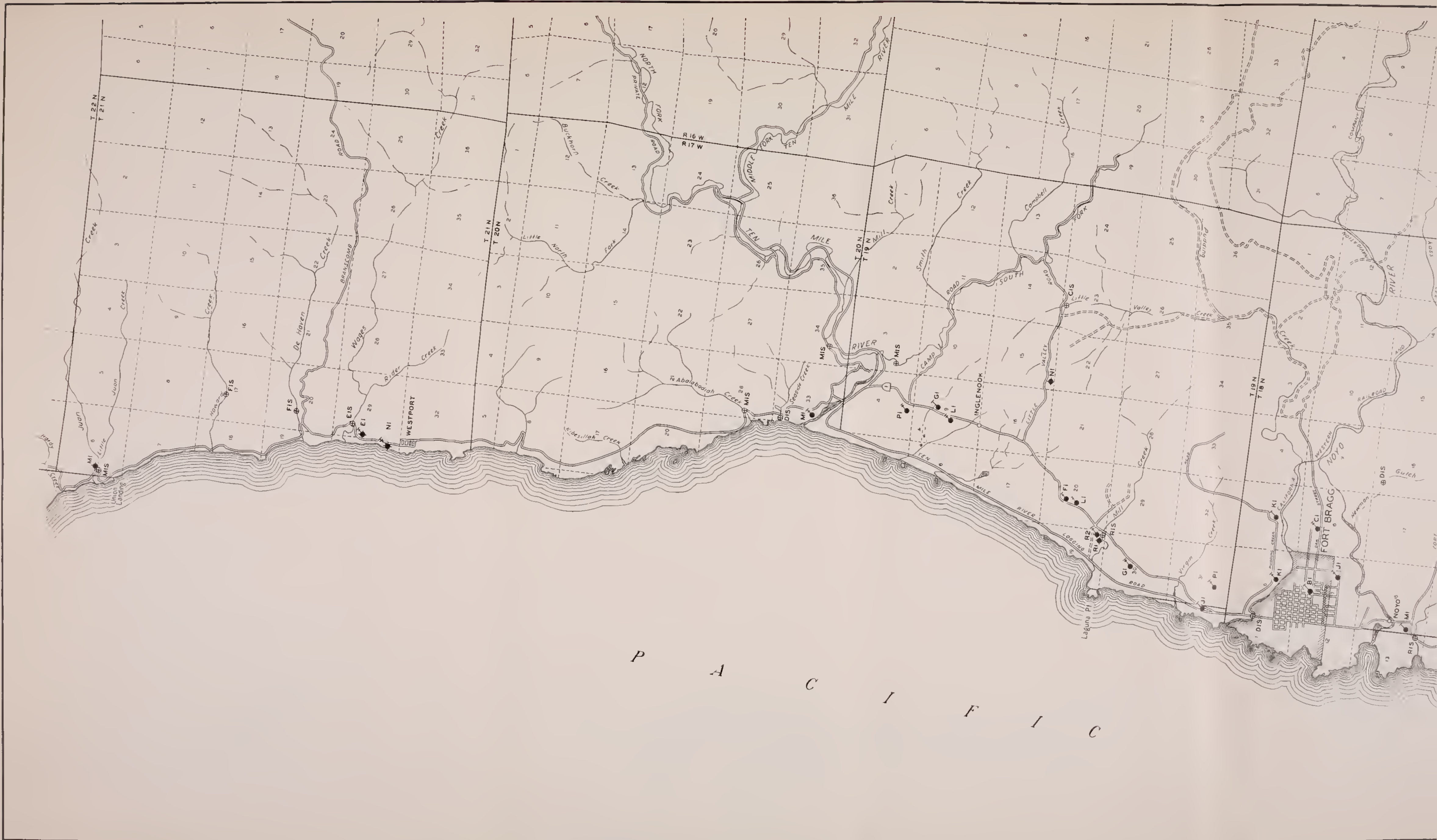
RECOMMENDED WATER WELL CONSTRUCTION AND SEALING STANDARDS MENDOCINO COUNTY

LOCATION OF WELLS AND SAMPLING POINTS IN FORT BRAGG TERRACE AND CONTIGUOUS AREAS

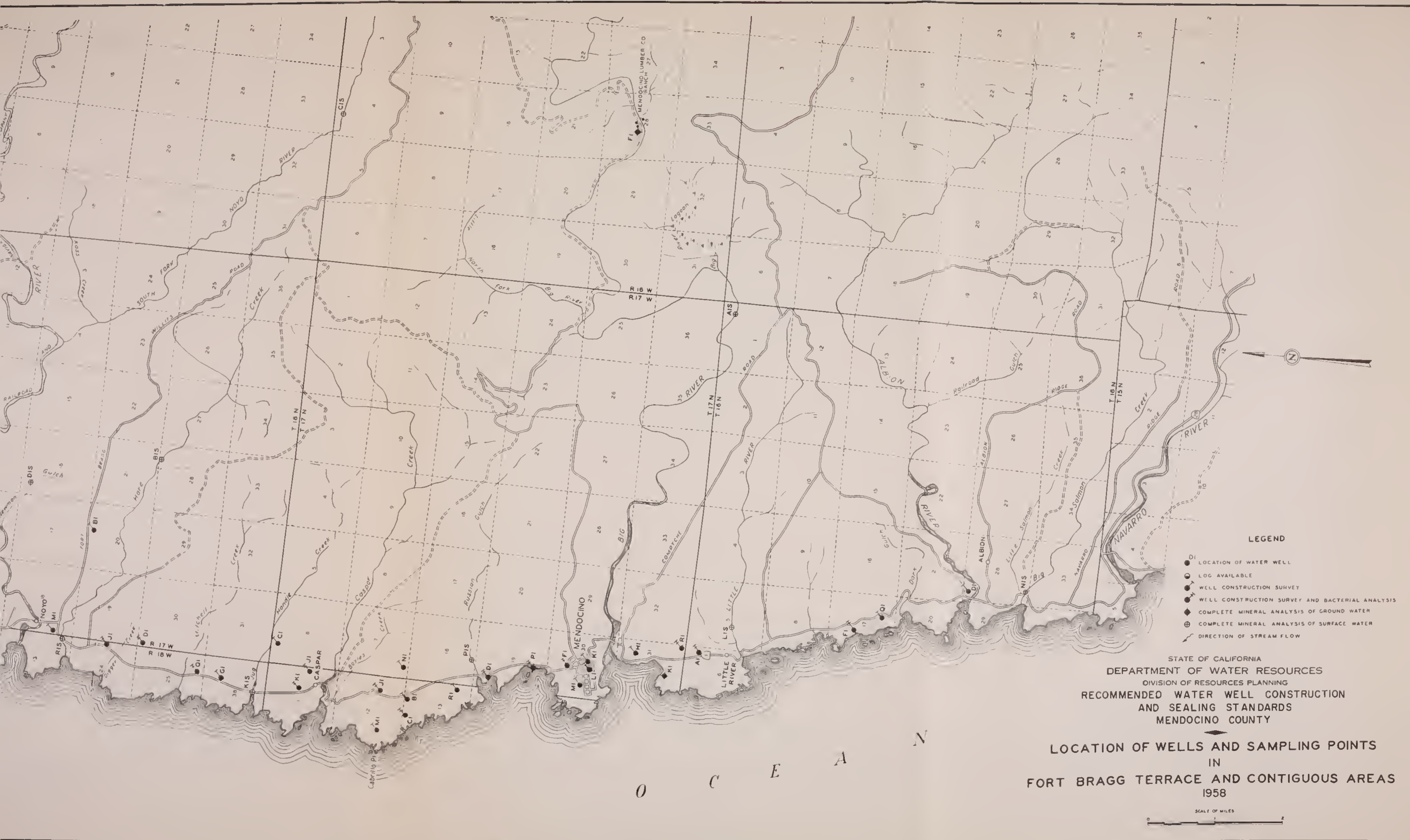
1958

SCALE OF MILES

0 1 2



P A C I F I C
FORT BRAGG
WESTPORT
INGLENOOK
NOYO
Union Landing
Laguna Pt
TEN MILE RIVER
NORTH FORK
MIDDLE FORK
SOUTH FORK
NOYO RIVER
De Haven Creek
Wages Creek
Howard Creek
Juan Creek
Little Juan Creek
Hardy Creek
Abalobadiah Creek
Kibesillah Creek
Seaside Creek
Smith Creek
Campbell Creek
Mill Creek
Virgin Creek
Pudding Creek
Little Valley Creek
Newman Gulch
Buckhorn Creek
Little North Fork
Rider Creek
Branscomb Road
Private Road
Camp Road
Logging Road
California Western Railroad
T 22 N
T 21 N
T 20 N
T 19 N
T 18 N
R 16 W
R 17 W


LEGEND
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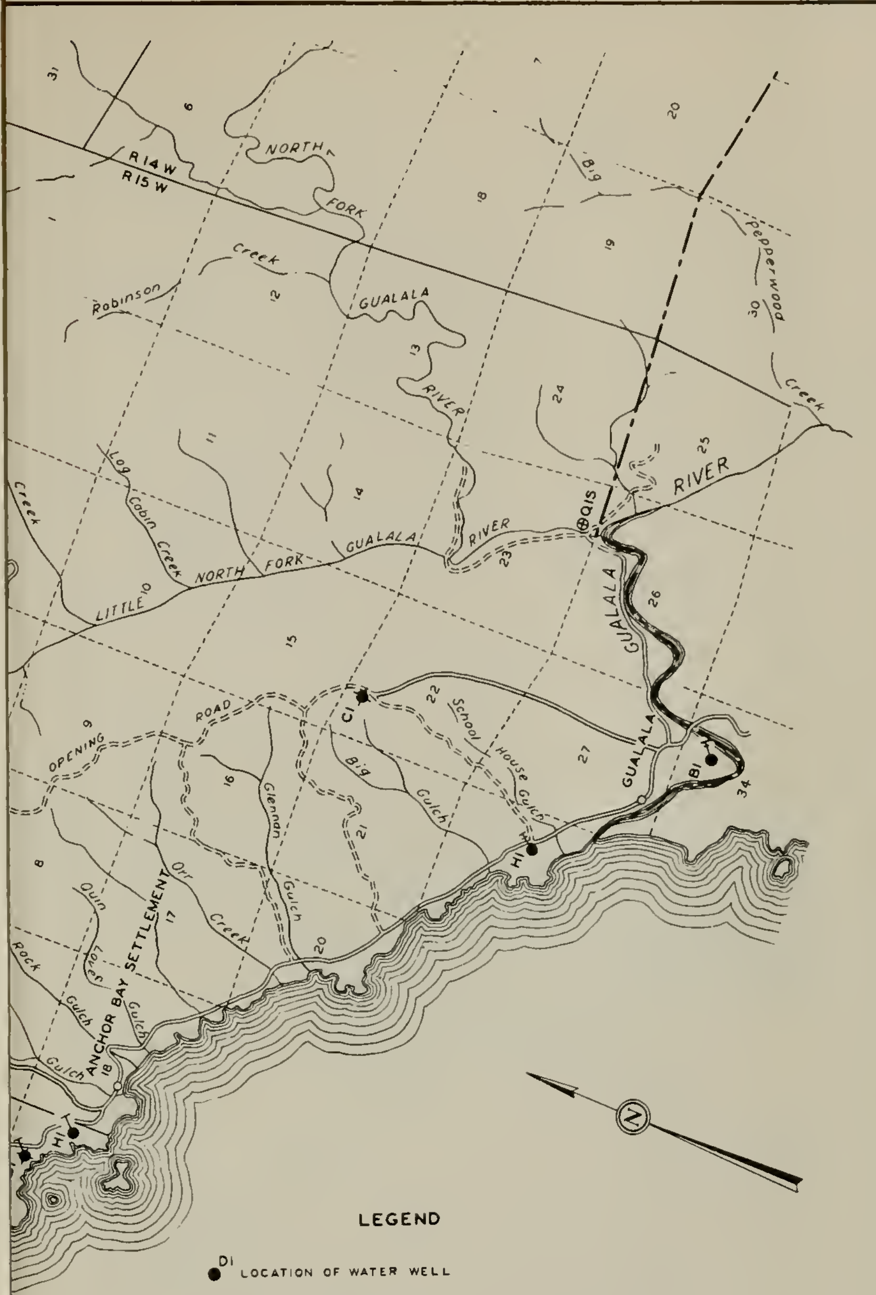
MENDOCINO COUNTY
LOCATION OF WELLS AND SAMPLING POINTS
IN
FORT BRAGG TERRACE AND CONTIGUOUS AREAS
1958
SCALE OF MILES
O C E A N
MENDOCINO
CASPAR
ALBION
LITTLE RIVER
NOYO
NAVARRO RIVER
ALBION RIVER
BIG RIVER
NOYO RIVER
MENDOCINO LUMBER CO RANCH
R 17 W
R 18 W
R 16 W
T 18 N
T 17 N
T 16 N
T 15 N



LEGEND

D1 LOCATION OF WATER WELL

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WELL CONSTRUCTION SURVEY AND BACTERIAL ANALYSIS

COMPLETE MINERAL ANALYSIS OF GROUND WATER

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MENDOCINO COUNTY

LOCATION OF WELLS AND SAMPLING POINTS IN POINT ARENA TERRACE AND CONTIGUOUS AREAS 1958

SCALE OF MILES

0 1 2


PACIFIC OCEAN
NAVARRO
RIVER
GARCIA
RIVER
POINT ARENA
MANCHESTER
LEGEND
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POINT ARENA TERRACE AND CONTIGUOUS AREAS
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